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A MONOGRAPHIC REVISION OF THE MEXICAN WATER BEETLES OF THE FAMILY ELMIDAE

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(With 401 text-figures.)

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INTRODUCTION.

THIS monograph owes its origin to an attempt to determine the Elmidae collected on an expedition undertaken by Dr. R. L. Usinger and the writer to Central Mexico in the summer of 1933. At the time great difficulty was experienced in assigning names to the various forms, the existing descriptions being too brief, and in most instances unaccompanied by illustrations of essential characters such as the male genitalia. It was also found impossible to determine the small amount of material available of the immature stages. In the summer of 1934 an opportunity was taken to collect again in Mexico, and on this expedition particular attention was paid to the immature stages. As a result it has been possible in nearly all instances to assign those stages to genera if not to species.

In this paper all available stages of each species are described and figured. Such parts of the internal anatomy as the alimentary canal, male and female reproductive organs and central nervous system are described and illustrated for all genera except one. It is believed that this is the first time that these characters of the

internal anatomy have been used in conjunction with those of the external anatomy for defining genera in any family of the Arthropoda.

Altogether 36 species and one subspecies belonging to eleven genera are described. Of these, nine species, one subspecies and two genera are described as new.

GENERAL REMARKS.

The Use of Quantitative Methods in Taxonomy.

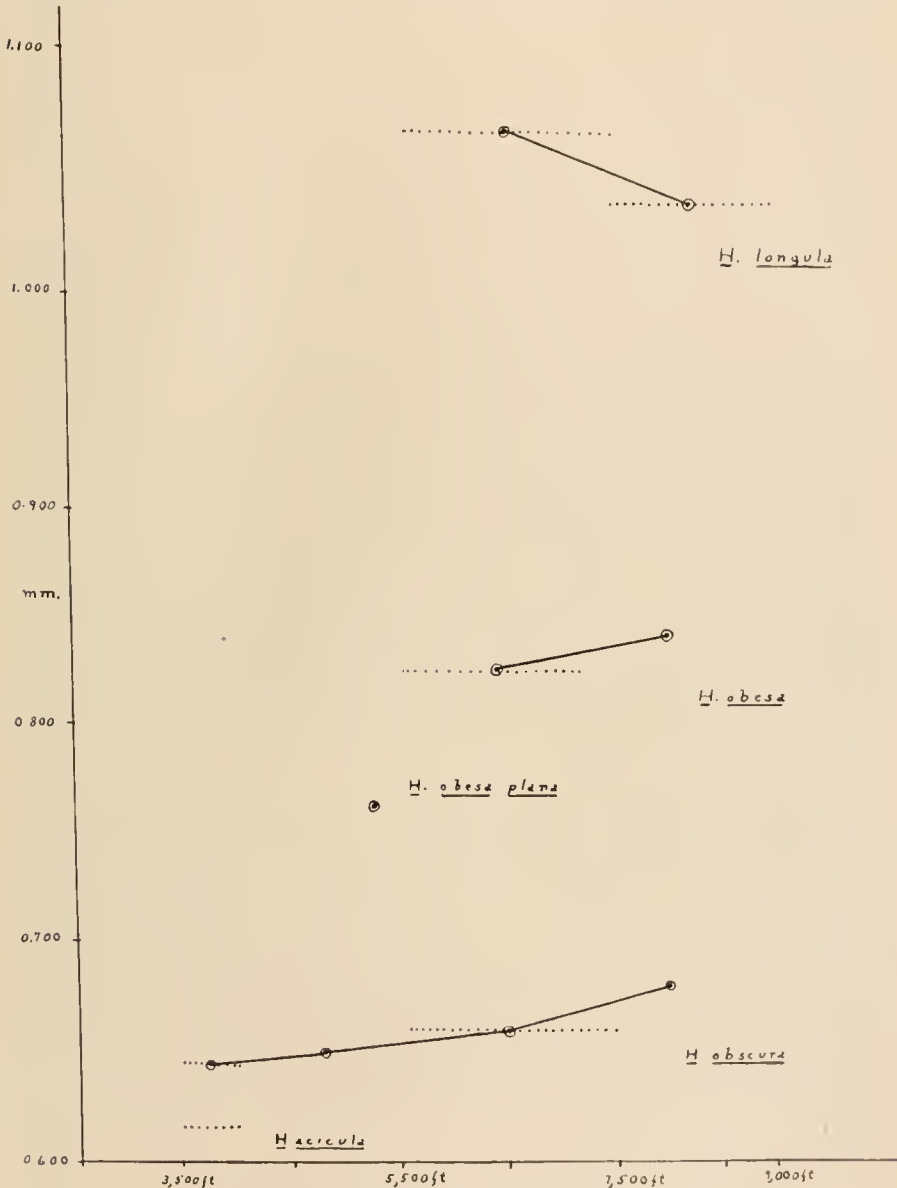
The application of quantitative methods to taxonomy has been much neglected. The usual taxonomic procedure has been, with few exceptions, entirely qualitative, and for the most part only those characters which are conspicuously discontinuous have been dealt with. The recent progress in the application of quantitative methods has been reviewed by Richards (1938). Only the influence of the environment on linear measurements will be discussed here.

It has been pointed out by Heincke (*vide* Richards, 1938), Zarapkin (1934) and Richards (1938) that most of the structures of two species differ significantly in the means of their measurements. This has always been found to occur among those species measured by the writer. From this fact it might be concluded that significant differences between the means of linear measurements of the structures of two populations are good specific characters. The writer has had experience with a group of insects living in a relatively stable environment, and therefore unusually suitable for such studies, and has found that in these quite a small difference in environment (in altitude and presumably in temperature) has resulted in significant differences between the means of most of the linear measurements of two populations belonging to the same species. Such significant differences are even apparent among populations of the same species from the same stream, associated with altitude differences of less than 1000 ft. (in Mexico at about 19° N.).

It is possible that in terrestrial insects the means of those living, for example, on the north side of a hill would differ significantly owing to a difference in temperature from those living on the south side of the same hill. It is also possible that for the same reason there would be a significant difference between the means of the same species living on opposite sides of a tree trunk. Apart from differences in absolute size that can be attributed to temperature, the mean size of populations is influenced by the type and quantity of food available in a particular locality, etc.

Although significant differences between the means of two populations are not in themselves always specific characters, it might be claimed that while small differences are not, very large differences are, and that in a particular genus or family it is only necessary to determine the degree of variation for each category in the taxonomic hierarchy. If this were true it could be said that two populations whose means differed by, say, 0.06 mm. belonged to different species, while differences of less than 0.06 mm. were of subspecific importance. It is true that, on the whole, interspecific differences in size are greater than intraspecific, but even in the writer's very limited experience cases have been found in which the means of different populations of the same species differ as widely as those of different species. For example, the difference between the means of the length of the prothorax of *Heterelmis obscura* taken at 8000 ft. and at 3500-4000 ft. is 0.034 mm., while the difference between the mean of *H. obscura* taken at 3500-4000 ft. and that of *H. acicula* taken in the same locality is only 0.022 mm. When a test of homogeneity is applied to these, it is found that the difference between *obscura* and *acicula* is significant to the same degree as that between the two populations of

H. obscura, i.e. $P < 10^{-3}$. Furthermore, if the general decrease in size with a decrease in altitude which has already been observed in *obscura* (text-fig. A) is



TEXT-FIG. A.—The mean length of the prothorax of five species of *Heterelmis* is plotted against the altitude at which the population occurred. The means were taken from populations of 14 to 75 individuals.

continued below the 3500 ft. level, at some point below this level the mean of the prothorax length will be equal to that of *acicula* at 3500-4000 ft.

If all aspects of the environment were identical for two populations and

significant differences could be found between the means of their linear measurements, such differences would be genetical. If these differences were not positively correlated with characters of known value, it would be left to the judgment of the observer to decide whether they were of specific or only of subspecific importance.

For ordinary taxonomic purposes quantitative work of the type dealt with above has a very limited application. Even in those cases where the specific means are very different, it should be noted that there is frequently an overlap in the measurements (*vide* text-figs. 366-368). This means that the species must be first segregated on qualitative characters before quantitative work can begin; and at that point, unfortunately, taxonomic work usually ends.

The genus *Heterelmis* (text-fig. A) has been studied more extensively than any other in this paper, and reveals the following general points: considering one species at a time, the mean length of the prothorax increases progressively with increase of altitude for *obscura* and *obesa obesa* (this is also true for *Microcylloepus inaequalis* and *Neoelmis longula*, p. 313 and p. 326); while for *longula* (occurring only at the highest altitudes) an increase of altitude is accompanied by a decrease of prothorax length. It is not known how far this effect of altitude is due to modification and how far to selection. It is quite possible that within *obscura*, for instance, certain genotypes are larger than others (in this genus length of prothorax is positively and highly correlated with absolute size, p. 379), and that the former flourish better at higher altitudes. It is probable, however, that a considerable part of this effect is due to the influence exerted during ontogeny, by the environment at different altitudes, on essentially the same genotypes. There is no information as to which factor in the environment at different altitudes is responsible for modifying size, but temperature may be suggested as the most likely possibility. As regards *longula*, it may be suggested that above certain altitudes—in this genus probably above 8000 ft. in lat. 19° N.—such factors of the environment as very low temperatures have a dwarfing effect.

Considering the relationship between the different species of *Heterelmis*, with regard to altitude and prothorax length, it appears from text-fig. A that the greater the mean altitude of the species the greater is the length of the prothorax (and therefore the greater the absolute size). The scanty data obtained for *obesa plana* and *acicula* are in general accord with this statement if it is remembered that *obesa plana* does not belong to the same section of the genus as *acicula* and *obscura*. Furthermore, when two species, e.g. *obscura* and *obesa obesa*, are compared in the same environment, at 5600-7500 ft. for instance, it is found that *obscura* is still much smaller—the difference in size being genetical. So it may be concluded that *the greater the size, as determined by genetical factors, the greater will be the altitude of the habitat to which the species will tend to be segregated.* Unpublished data on a number of genera in this and other families support this general principle.

The Use of the Internal Anatomy in Classification.

The use of internal characters in dealing with groups of family or superfamily rank in the taxonomic hierarchy has been dealt with already.¹ It is only necessary here to point out that without the use of such characters it is much more difficult, and in many instances impossible, to build a system of

¹ 1939, *Trans. R. Ent. Soc. Lond.*, 89: 133-184, 1 pl., 105 figs.

classification which gives even an approximate picture of the phylogeny of the groups involved.

In the classification of the categories of lower rank, such as genera and species, the internal anatomy has very seldom been used in the Arthropoda. Practically without exception, genera are based entirely on the characters of the external morphology. In the writer's experience there appear to be almost as many characters of the internal anatomy which can be considered to be of generic importance. The present study of the internal anatomy of a number of genera has in some cases modified the conception of generic limits.

If the species of Elmidae of which the characters of the internal anatomy are known be divided into genera solely on these characters, the resulting genera frequently correspond exactly to genera which taxonomists have previously founded on external structures alone. However, in some groups, e.g. *Elsianus*, where the application of generic criteria used in the past, such as the presence or absence of sublateral carinae on the pronotum, would have resulted in two and possibly three genera, the similarity of the internal anatomy has caused a more careful search for characters of the external anatomy which could be considered to be of generic importance. This has led to the discovery of the generic importance of such characters as the venation of the hind wings and the distribution of the tomentose areas on the body—characters almost entirely neglected in previous descriptions of genera. In the particular case of *Elsianus*, it might be mentioned that the extent of the genus first suspected from a study of the internal anatomy is supported by a study of the larvae.

Until now the genus *Cylloepus* seemed to consist of a fairly homogeneous assembly of species, but an examination of the internal anatomy shows that the species fall into two very distinct groups. These groups differ from each other in the number of egg tubes to each ovary, the place of entry of the spermathecal duct into the bursa copulatrix, the form of the lateral accessory glands of the male, the number of caeca on the anterior margin of the midgut, and the number of Malpighian tubules. Experience of the family gained elsewhere shows that all these characters are of generic importance, and from this it is concluded that the two groups are really very different genera. The only character of the external anatomy which has been found to be correlated with these differences in the internal anatomy is the absence or presence of a transverse belt of tomentum on the hypomera. The species having a transverse belt of tomentum on the hypomera have been placed in a new genus, *Hexacylloepus*. Among the described species of *Hexacylloepus* a considerable amount of variation in the extent of the tomentose belt is already evident; and it is possible that when more species are known, some will be found in which the tomentose belt is not developed. If this were to occur, it would be necessary to study the soft parts of the internal anatomy before these species could be placed in their proper genus. It is believed that sooner or later, among some groups of genera in the family, dissection of the soft parts of the internal anatomy will be necessary before the species can be referred to their respective genera.

No one to-day would claim that all genera should be distinguished solely on characters of the antennae. Almost everyone would agree that all characters of the external anatomy of the adults should be used in defining genera and in attempting to build natural systems of classification; and many would insist that the external anatomy of other stages be considered also. However, in practice, if not in theory, most systematists still draw a very sharp line between characters of the external and internal anatomy.

Specific differences in the internal anatomy certainly occur, and are often more conspicuous than external differences. In the writer's very limited experience specific differences are not as numerous in the gross structure of the soft parts of the internal anatomy as they are in the structure of the external anatomy. No instance has yet been observed of two species differing only in the structure of the soft parts of the internal anatomy. There is no theoretical reason why species differing in a few genes should not have the effect of these genes confined to these parts.

METHOD.

While describing the species the problem arose as to how far the descriptions should be complete. To describe and illustrate in detail every structure on the body of each species is for all practical purposes a generally recognized impossibility. Any modification of this procedure rests upon the judgment of the individual worker. Some solve this problem by describing only those characters which will enable one to separate the species from those already described in the same genus. In practice this means that each time a new species, which differs in structural details from those previously described, is added to a genus it becomes necessary to re-examine and redescribe all the species; and if such a standard is accepted, whenever species are added to a genus, all other specific descriptions in that genus must be revised. Fortunately a slightly higher standard generally prevails to-day. The systematist selects from the characters that he sees those which by comparison with other species of the genus, or by analogy with the species of related genera, appear to him to be important; and to these he adds a few characters which he thinks are likely to prove useful when more species are known, but makes no attempt at anything approaching a complete description.

It has already been pointed out that a really complete description is a practical impossibility, and that anything short of this must, at least where those genera to which many species will be added are concerned, involve a certain amount of redescription. The amount of redescription necessary is governed largely by the number of species later added to the genus and the accuracy and completeness of the existing specific descriptions. Although all redescription cannot be avoided, an attempt is made here to describe and figure each species in such detail that redescription will be reduced to a minimum, or, in those genera of which few species remain to be discovered, will not be necessary at all. However, if other criteria are in the future needed to distinguish satisfactorily the species of Elmidae, *e.g.* the number of branches of the recurrent nerve or the biochemical properties of some tissue, the descriptions given here will have to be rewritten.

Previous workers have seldom given precise measurements of the various structures, and statements such as "prothorax longer than broad" are the rule. It has been found that this degree of accuracy is not usually sufficient, and in the descriptions given here the exact measurements have been made with the aid of an eyepiece micrometer. It has also been found necessary to describe more accurately than has been the custom the distribution of punctures and tubercles. Statements such as "punctures coarse," "tubercles moderately dense," etc., have been found to be too subjective and have been avoided by giving the exact diameters of the punctures, or else comparing them with structures already measured or found to be specifically stable, *e.g.* the facets of the

eyes. The density of the tubercles and punctures has been expressed in terms of their own diameters.

The 13 illustrations of the adult beetles were done by Miss O. F. Tassart. All other illustrations were done by the writer with the aid of a camera lucida. Lines next to figures refer to a length of 0.20 mm. unless otherwise indicated.

MATERIAL.

The descriptions of the internal anatomy are drawn from species collected by the writer in Bolivia, Brazil, French Guiana, Trinidad (B.W.I.), and England.

The material which forms the basis of this monograph was collected by Dr. R. L. Usinger and the writer in central Mexico during the summer of 1933, and by the writer in the same region in the summer of 1934. The entire collections of Elmidae in the British Museum (Natural History) have been available, as have also the Mexican and Central American Elmidae in the collections of the U.S. National Museum, the Museum of Comparative Zoology at Harvard College, the Deutsches Entomologisches Institut at Berlin-Dahlem, and the Muséum National d'Histoire Naturelle of Paris. Collections of Elmidae have also been sent by a number of individuals.

The following is a list of all the specimens of the species known to occur in Mexico examined by the writer :

1. <i>Hexanchorus gracilipes</i> Sharp.		<i>A. sulcicollis</i> (Sharp).	
Adults . . . Panama . . .	2.	Adults . . . Panama . . .	6.
" . . . Costa Rica . . .	2.	" . . . Mexico . . .	9.
" . . . Mexico . . .	1176.	<i>Xenelmis bufo</i> (Sharp).	
Pupa . . . " . . .	1.	Adults . . . Panama . . .	2.
Larvae . . . " . . .	26.	" . . . Mexico . . .	48.
<i>Phanoceus clavicornis</i> Sharp.		<i>Microcylloepus angustus</i> , sp. n.	
Adults . . . Guatemala . . .	7.	Adults . . . Mexico . . .	18.
" . . . Mexico . . .	4.	" . . . " . . .	
" . . . Brazil . . .	82.	<i>M. troilus</i> , sp. n.	
Larvae . . . Guatemala . . .	7.	Adults . . . " . . .	1290.
<i>Tobriolus ungulatus</i> (Hinton).		<i>M. inaequalis</i> (Sharp).	
Adults . . . Mexico . . .	951.	Adults . . . Guatemala . . .	34.
Larvae . . . " . . .	20.	" . . . Mexico . . .	2926.
<i>Elsianus grandis</i> Hinton.		Larvae . . . " . . .	22.
Adults . . . " . . .	11.	<i>M. obesus</i> , sp. n.	
<i>E. graniger</i> Sharp.		Adults . . . Guatemala . . .	4.
Adults . . . Costa Rica . . .	1.	<i>Neoelmis apicalis</i> (Sharp).	
" . . . Mexico . . .	82.	Adults . . . " . . .	4.
Pupae . . . " . . .	18.	" . . . Mexico . . .	271.
Larvae . . . " . . .	75.	<i>N. aspera</i> , sp. n.	
<i>E. sandersoni</i> Hinton.		Adults . . . " . . .	10.
Adults . . . " . . .	6.	<i>N. acteca</i> , sp. n.	
<i>E. scutellaris</i> Hinton.		Adults . . . " . . .	2.
Adults . . . " . . .	14.	<i>N. longula</i> Hinton . . .	
<i>E. striatoides</i> Hinton.		Adults . . . " . . .	148.
Adults . . . " . . .	6.	<i>Hexacylloepus abditus</i> Hinton.	
<i>E. striatus</i> Sharp.		Adults . . . Mexico . . .	57.
Adults . . . Guatemala . . .	1.	<i>H. apicalis</i> , sp. n.	
" . . . Mexico . . .	228.	Adults . . . " . . .	177.
Larvae . . . " . . .	110.	<i>H. horni</i> Hinton.	
<i>Elsianus</i> sp. ?.		Adults . . . " . . .	3.
Larvae . . . " . . .	1.	<i>H. scabrosus</i> , sp. n.	
<i>Elsianus</i> ? sp. ?.		Adults . . . " . . .	4.
Larvae . . . " . . .	3.	<i>Cylloepus blairi</i> Hinton.	
<i>Austrolimnius formosus</i> (Sharp).		Adults . . . " . . .	27.
Adults . . . Guatemala . . .	2.	<i>C. heterocerus</i> (Sharp).	
" . . . Mexico . . .	40.	Adults . . . Guatemala . . .	7.
		" . . . Mexico . . .	4.

<i>C. proximus</i> Hinton.		<i>H. obesa obesa</i> Sharp.	
Adults . . . Mexico	1.	Adults . . . Guatemala	9.
<i>C. puncticollis</i> (Hinton).		" . . . Mexico	5003.
Adults . . . "	130.	<i>H. obesa plana</i> , subsp. n.	
<i>C. sculptipennis</i> (Sharp).		Adults . . . "	1194.
Adults . . . Guatemala	1.	<i>H. obscura</i> Sharp.	
" . . . Mexico	11.	Adults . . . Guatemala	38.
<i>C. sexualis</i> Hinton.		" . . . Costa Rica	2.
Adults . . . "	98.	" . . . Mexico	1607.
<i>C. spinipes</i> Hinton.		" . . . Texas	1.
Adults . . . "	94.	<i>H. tarsalis</i> , sp. n.	
<i>Cyloepus</i> sp. ?		Adults . . . Mexico	1.
Larvae . . . "	2.	<i>Heterelmis</i> .	
<i>Heterelmis acicula</i> , sp. n.		Larvae of several	154.
Adults . . . "	32.	spp.	
<i>H. longula</i> Sharp.		Total specimens	16,500.
Adults . . . "	167.		

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I am grateful to the Managers of the Balfour Fund (University of Cambridge) for a grant of £200 and to those of the Worts Fund for a grant of £40 which enabled me to work on the biology of some of the South American Elmidae, and to collect properly preserved material for my studies on the internal anatomy.

A KEY TO THE TRIBES OF THE ELMIDAE.

- i. Adults terrestrial, rarely entering the water. Body never with tracts of tomentum. Front coxae usually strongly transverse and with the trochantin exposed. Abdomen frequently with six visible ventral segments LARINI.
- Adults aquatic, seldom or never leaving the water. Body with tracts of tomentum. Front coxae usually round and with the trochantin concealed. Abdomen never with more than five visible ventral segments ELMINI.

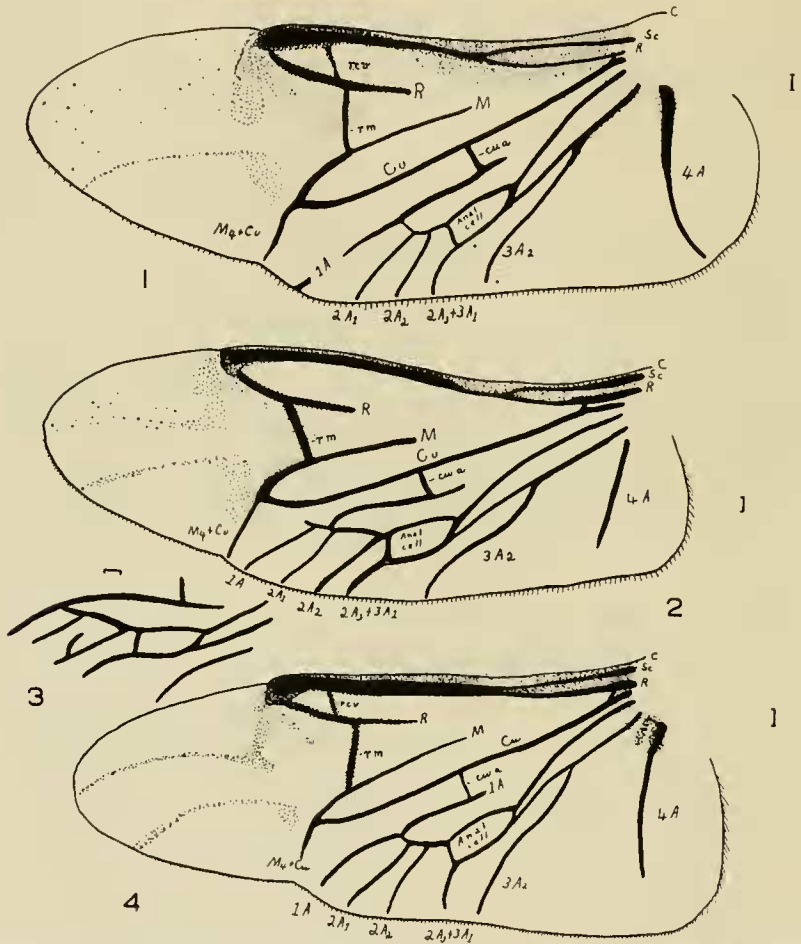
The tribe Ancyronychini (1904, Ganglbauer, *Die Käfer von Mitteleuropa*, 4 (1) : 108) should be relegated to synonymy with the tribe Elmini. According to Ganglbauer the Ancyronychini are to be separated from the Elmini by the very short prosternum in front of the anterior coxae with a consequent exposure of the ventral surface of the head. The length of the prosternum in front of the anterior coxae is not always even a good generic character. Among the species of *Stenelmis* may be found many which have the prosternum in front of the anterior coxae extremely long and the head fully retractile, while many, e.g. *S. pallidipes* (Cart.), etc., have the prosternum very short and the ventral surface of the head even more exposed than in *Ancyronyx* Er.

A detailed study of the relationships of the Larini to the Elmini has been made before, and it is only necessary to repeat here that it was found that there was only one character by means of which these two tribes could be infallibly separated, *i.e.* the presence of tomentose tracts in all Elmini and their absence among the Larini. It has been shown that this division into two tribes is not a very natural one, as it is supported neither by the structure of the larvae nor by that of the pupae, and furthermore one genus, *Phanoceroides* Hinton, is referred to the Elmini, but is really much more closely related to some of the Larini than to any known members of the Elmini.

A KEY TO THE WORLD GENERA OF LARINI.

1. Prosternum broadly truncate posteriorly or at most feebly rounded ; mesosternum without a depression for the reception of the prosternal process. Elytra with two accessory basal striae on each elytron between sutural and second stria. AFRICA, MADAGASCAR
Potamodytes Grouv. (1896).
Prosternum acute posteriorly ; mesosternum with a depression for the reception of the prosternal process. Elytra with one accessory stria or none on each elytron between sutural and second stria 2.
2. Elytra with one accessory stria on each elytron 3.
Elytra without accessory striae 8.
3. Pronotum on each side with a longitudinal carina or sulcus on basal two-fifths. NEW ZEALAND, AUSTRALIA *Hydora* Broun (1882).
Pronotum without basal carinae or sulci 4.
4. Pronotum evenly convex. AFRICA, MADAGASCAR *Hydrethus* Fairm. (1889).
Pronotum with an apical transverse impression which at middle is on anterior third and at sides on anterior fifth or sixth. This impression is but little developed in some genera, *e.g.* *Potamophilus* 5.
5. Hind wing with a radial cross vein (text-fig. 1). WESTERN NORTH AMERICA *Lara* Lec. (1852).
Hind wing without a radial cross vein 6.
6. Second anal with either branch one or branch two absent ; between first anal and third branch of second anal (plus first branch of third anal) with only one vein. EAST INDIES, AFRICA
Potamophilinus Grouv. (1896).
Second anal with first and second branches present so that between first anal and third branch of second anal plus first branch of third anal there are two veins 7.
7. First branch of third anal joined to second anal before the latter has given rise to any branches, the point at which these two become united being a distance greater than the diameter of the anal cell proximal to the anal cell. AUSTRALIA *Stetholus* C. & Z. (1929).
First branch of third anal joined to third branch of second anal (*i.e.* joined to second anal after the latter has given rise to branches, text-fig. 2). EUROPE, EAST INDIES (?) *Potamophilus* Germ. (1811).
8. Pronotum on each side with a longitudinal carina or sulcus on basal two-fifths 9.
Pronotum without a carina or sulcus on each side 10.
9. Pronotum without transverse impressions ; prosternum very broad between coxae. JAPAN *Dryopomorphus* Hinton (1936).

- Pronotum with a transverse impression on each side at apical third, this impression extending mesally and posteriorly to join the impression formed by the longitudinal sulcus. NORTH and SOUTH AMERICA, WEST INDIES *Phanocerus* Sharp (1882).
10. Pronotum with a strong transverse impression on apical third at middle and at apical fifth or sixth at sides. CENTRAL and SOUTH AMERICA *Hexanchorus* Sharp (1882).
- Pronotum without a transverse impression. CENTRAL and SOUTH AMERICA *Disersus* Sharp (1882).



TEXT-FIGS. 1-4.—(1) *Lara avara amplipennis* Darl. (2) *Potamophilus acuminatus* (F.). (3) Wing of other side of same specimen drawn from ventral side to facilitate a comparison with the normal type of venation. (4) *Potamodytes tuberosus* Hinton. Venation after Forbes.

Potamophilops Grouvelle (1896) would run to *Hexanchorus* in this key. The type has been examined in the Paris Museum and appears to be identical with *Hexanchorus*. However, at that time the wing venation was not examined,

and it is just possible that *Potamophilops* is a valid genus. *Betelmis* Matsumura (1916) was referred by its author to the Larini. As nearly as I am able to judge from the description and figure, this genus belongs in the family Psephenidae, where it is possibly synonymous with *Mataeopsephenus* Waterhouse.

The hind wings of the Coleoptera have seldom been used for separating genera. Apart from the fact that other characters are usually more readily accessible, in most groups of beetles the hind wings are frequently atrophied; and it is this tendency towards reduction which is the most serious objection to their use as generic characters. In those groups in which reduction of the wings is known to occur, the genera should never be distinguished solely by some wing character, e.g. venation, which is known to be affected by reduction, for this would often result in the difficult position of having some species represented only by individuals with reduced wings, and these individuals could not be assigned to their proper genera. But even in those groups in which reduction of the size of the wings with consequent reduction of the venation is known to occur, it is possible, and often even necessary, to use the venation as a supplementary generic criterion. In the tribe Elmini, as will be shown in my study of the Mexican genera, reduction of the wing venation is a frequent occurrence, and yet a consideration of the venation of those individuals which have fully developed wings is an aid to a fuller understanding of important generic relationships.

The Larini are a group which is not truly aquatic but is riparian. The adults are among the most agile of flying beetles, and after studying their habits it is difficult to imagine atrophy of the wings occurring except at very infrequent intervals. No individual that has been examined—individuals of most of the described species have been examined—has shown the slightest tendency towards reduction of the wings. Other families of beetles possessing strictly riparian tribes or groups of genera resemble the Larini in that the wings are seldom if ever reduced. Darlington (1936), who has studied the hind wings of the Carabidae, says (p. 157), “. . . almost without exception species which live closely associated with water have strongly developed flying wings” (italics are his).

A KEY TO THE GENERA OF MEXICAN ELMINI.¹

- 1. Maxillary palp 3-segmented. Mid-gut with prominent regenerative crypts; anterior margin without caeca. EUROPE *Elmis* Latr. (1798).
 Maxillary palp 4-segmented. Mid-gut smooth, without regenerative crypts projecting from the outer surface; anterior margin with or without caeca 2.
- 2. Base of pronotum feebly rounded in front of scutellum. Claws toothed. MEXICO *Tolriolus*, gen. n.
 Base of pronotum arcuately emarginate in front of scutellum. Claws without teeth 3.
- 3. Each elytron with a short accessory stria at base between first and second striae. Each testis composed of three sperm tubes. NORTH and SOUTH AMERICA *Elsianus* Sharp (1882).
 Elytra without accessory striae. Each testis composed of one or two sperm tubes 4.

¹ In this key I have included two genera not found in Mexico, *Limnius* and *Elmis*, since in the past a number of Mexican species have been referred to one or another of these.

4. Epipleura with a longitudinal line of granules which on anterior two-fifths is half way between dorsal and ventral margins, while on posterior three-fifths it is close and parallel to ventral margin. Hind wing with a well-developed anal lobe. Alimentary canal with five caeca on the anterior margin of the mid-gut. Each testis composed of only one sperm tube. Each ovary with only two egg tubes. Central nervous system with only the second and third abdominal ganglia discrete. AUSTRALIA, CENTRAL and SOUTH AMERICA

Austrolimnius C. & Z. (1929).

Epipleura without a longitudinal line of granules. Hind wing without a well-developed anal lobe. Alimentary canal never with five caeca on anterior margin of mid-gut. Each testis composed of two sperm tubes. Each ovary with more than two egg tubes. Central nervous system with a different combination of discrete abdominal ganglia 5.

5. Mentum twice as long as and broader than submentum. Each elytron with three carinae or longitudinal rows of granules. Alimentary canal with four caeca on the anterior margin of the mid-gut. EUROPE, NORTH AMERICA *Limnius* Er. (1847).

Mentum never distinctly broader and always shorter than submentum. Each elytron with at most two sublateral carinae. Alimentary canal never with four caeca on the anterior margin of the mid-gut 6.

6. Pronotum entirely tomentose. Hypomera entirely tomentose. Pronotum without sublateral carinae. Hind wing without a cubito-anal cross vein. Alimentary canal without caeca on the anterior margin of the mid-gut. Central nervous system with only the second abdominal ganglion discrete. CENTRAL and SOUTH AMERICA

Xenelmis Hinton (1936).

Pronotum not tomentose. Hypomera never completely tomentose. Pronotum with a sublateral carina on each side. Hind wing with a cubito-anal cross vein which may be complete or incomplete. Alimentary canal always with caeca on the anterior margin of the mid-gut. Central nervous system with at least three discrete abdominal ganglia 7.

7. Hypomera never tomentose. Pronotum on apical two-fifths always with at least a moderately deep transverse impression which may be complete or confined to sides. Alimentary canal with two, three, or no caeca on anterior margin of mid-gut. Each ovary with six or less than six egg tubes 8.

Hypomera usually at least partly tomentose. Pronotum occasionally with transverse impressions but these are never on apical two-fifths. Alimentary canal with more than three caeca on anterior margin of mid-gut. Each ovary with more than six egg tubes 9.

8. Pronotum with a moderately deep, occasionally incomplete, transverse impression, with a median longitudinal discal impression; on basal half on each side with an oblique impression. Each elytron with two sublateral carinae, only very rarely with one. Epipleura only rarely tomentose. Hind wing without a trace of an anal lobe; third anal joining second anal. Alimentary canal with two caeca on the anterior margin of the mid-gut; hind gut with six Malpighian tubules. Each ovary with six egg tubes. Central nervous system with the first three abdominal ganglia discrete. NORTH and SOUTH AMERICA

Microcylloepus Hinton (1935).

Pronotum always with a very deep and complete transverse impression ; never with a median longitudinal impression on disk nor with an oblique impression on basal half. Each elytron always with only one sublateral carina. Epipleura always tomentose. Hind wing with a feebly developed anal lobe ; third anal not joining second anal. Alimentary canal with three, two, or no caeca on the anterior margin of the mid-gut. Hind gut with only four Malpighian tubules. Each ovary with four egg tubes. Central nervous system with the first six abdominal ganglia discrete. NORTH and SOUTH AMERICA, WEST INDIES *Neelmis* Musgr. (1935).

9. Hypomera with a complete transverse belt of tomentum. Hind gut with only four Malpighian tubules. Male reproductive system with the lateral accessory glands not lobed. Each ovary with seven egg tubes. NORTH and SOUTH AMERICA *Hexacylloepus*, gen. n.

Hypomera without a complete transverse belt of tomentum. Hind gut with six Malpighian tubules. Male reproductive system with the lateral accessory glands lobed. Each ovary with more than seven egg tubes 10.

10. Body subparallel. Hypomera usually without tomentum but occasionally with a very narrow belt on anterior three-fifths adjacent to sterno-notal suture. Hind wing with the second branch of the third anal present. Prosternal process moderately narrow. Alimentary canal with eight caeca on the anterior margin of the mid-gut. Each ovary with about 18 egg tubes. Spermathecal duct opening into base of bursa copulatrix. Central nervous system with abdominal ganglia two to five discrete. NORTH and SOUTH AMERICA, WEST INDIES *Cylloepus* Er. (1847).

Body usually obovate. Hypomera always with a ventral belt of tomentum which at broadest point is two-fifths as broad as hypomera. Hind wing with the second branch of the third anal absent. Prosternal process broad. Alimentary canal with six caeca on the anterior margin of the mid-gut. Each ovary with 11 egg tubes. Spermathecal duct opening into the apex of the bursa copulatrix. Central nervous system with abdominal ganglia one to six discrete. NORTH and SOUTH AMERICA *Heterelmis* Sharp (1882).

A KEY TO THE LARVAE OF THE GENERA OF ELMIDAE.

1. Body flattened and usually at least feebly onisciform 2.
 Body cylindrical or subcylindrical 5.
2. Posterior margin of pronotum with a double row of tubercles. EUROPE
Dupophilus Muls. (1872).
 Posterior margin of pronotum with a single row of tubercles 3.
3. Propleura not divided into an anterior and a posterior part ; meso- and metapleura divided into three parts on each side. BRAZIL
Phanoceroides Hinton (1938).
 Propleura divided into an anterior and a posterior part on each side ; meso- and metapleura divided into two parts on each side 4.
4. Eighth abdominal segment with the pleura bounded by tergo- and sterno-pleural sutures. NORTH and SOUTH AMERICA, WEST INDIES
Phanocerus Sharp (1882).

- Seventh and eighth abdominal segments without discrete pleura and both segments forming complete sclerotized rings. EUROPE
Elmis Latr. (1798).
5. Propleura divided on each side into three parts 6.
Propleura not divided, or if divided then only into two parts on each side 10.
6. Pleura bounded by sutures present on eighth abdominal segment.
WESTERN NORTH AMERICA *Lara* Lec. (1852).
Eighth abdominal segment forming a complete sclerotized ring 7.
7. Pleura bounded by sutures present on seventh abdominal segment 8.
Seventh abdominal segment forming a complete sclerotized ring 9.
8. Head with one ocellus on each side. Dorsal surface evenly convex.
EUROPE, NORTH AMERICA *Limnius* Er. (1847).
Head with five ocelli on each side. Dorsal surface with numerous large gibbosities. EUROPE *Potamophilus* Germ. (1811).
9. Pleura bounded by sutures present on sixth abdominal segment.
CENTRAL and SOUTH AMERICA *Hexanchorus* Sharp (1882).
Sixth abdominal segment forming a complete sclerotized ring; fifth with pleura bounded by sutures. BOLIVIA *Disersus* Sharp (?) (1882).
10. Propleura not divided, meeting on middle line of body so that sternum is suppressed. Meso- and metapleura with only the sterno-pleural suture present. NORTH and SOUTH AMERICA, WEST INDIES
Cylloepus Er. (1847).
Propleura divided into an anterior and a posterior part, and only with the anterior part meeting on the middle line of the body. Meso- and metapleura bounded by tergo- and sterno-pleural sutures 11.
11. Meso- and metapleura divided on each side into two parts 12.
Meso- and metapleura divided on each side into three parts. NORTH and SOUTH AMERICA *Heterelmis* Sharp (1882).
12. Pleura bounded by sutures present only on the first two abdominal segments 13.
Pleura bounded by sutures present on more than the first two abdominal segments 14.
13. Dorsal surface of body evenly convex. EUROPE *Latelmis* Reitt. (1883).
All abdominal segments except ninth with the posterior part transversely and strongly gibbous. EUROPE *Riolus* Muls. (1872).
14. Pleura bounded by sutures present on the first six abdominal segments.
EUROPE *Esolus* Muls. (1872).
Pleura bounded by sutures present on the first seven abdominal segments 15.
15. Dorsal surface with numerous strong gibbosities. MEXICO
Tolriolus, gen. n.
Dorsal surface except for ninth abdominal segment evenly convex 16.
16. Tubercles of terga of first eight abdominal segments arranged in parallel rows. NORTH and SOUTH AMERICA *Microcylloepus* Hinton (1935).
Tubercles of terga of first eight abdominal segments not arranged in parallel rows 17.
17. Anterior margin of head on each side with a large and conspicuous tooth. NORTH and SOUTH AMERICA *Elsianus* Sharp (1882).
Anterior margin of head on each side without a distinct tooth 18.

18. Anterior margin of clypeus on each side with a moderately large acute tooth. Hind gut with six Malpighian tubules. SOUTH AMERICA
Macrelmis Mots. (1859).
 Anterior margin of clypeus not toothed. Hind gut with only four Malpighian tubules. NORTH and SOUTH AMERICA
Neelmis Musgr. (1935).

In this key I have included all the genera represented in my collection as well as *Dupophilus* Muls., which is known to me only by the description of Bertrand (1936). The larvae of three other genera, *Ancyronyx* Er., *Macronychus* Mull., and *Stenelmis* Duf., have been described and figured in the literature at various times, but in none of these descriptions have the important generic characters been mentioned, so that it is not possible to deal with them here.

No character has been found which will serve to separate the larvae of the Larini from those of the Elmini. As may be seen from the key, some members of the Larini, e.g. *Phanocerus*, are much more closely related to members of the Elmini than they are to members of their own tribe. Most Larini are much larger than the largest Elmini, so that the large size of the mature larvae (usually more than 7.0 mm. long and 1.5 mm. broad) is a useful character for distinguishing the larvae of the two tribes. This in combination with those forms determined by elimination and locality and by breeding has enabled me to identify the larvae of all American genera of Larini with the doubtful exception of *Disersus* Sharp.

THE MEXICAN LARINI.

Two species of Larini occur in Mexico, *Hexanchorus gracilipes* Sharp and *Phanocerus clavicornis* Sharp. A redescription of these two species with a description of their immature stages follows.

HEXANCHORUS Sharp.

1882. *Hexanchorus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 127.
 1896. *Hexanchorus* (err. typ. ?) Grouvelle, *Bull. Soc. ent. Fr.*, 1896 : 78.

Body elongate, subparallel ; clothed for the most part with dense, moderately long, usually recumbent hairs. *Head* when seen from below not capable of being retracted into prothorax beyond the basal portion of the submentum. Antenna as figured (text-fig. 8), 11-segmented. Mandibles with one obtuse subapical and two obtuse apical teeth ; prostheca large and entirely membranous. Maxillary palp (text-fig. 11) 4-segmented and stipes with a well-developed palpifer ; galea and lacinia separate and each densely spinose. Labial palp 3-segmented and prementum with a palpiger. Mentum broader than and as long as submentum. Gula at apex as broad as first segment of antenna. *Pronotum* with a complete and deep apical impression which at middle is about on apical third and at sides on apical fifth ; without longitudinal carinae. *Elytra* striate and punctate ; without accessory striae and without longitudinal carinae. Hind wing (text-fig. 12) without a radial cross vein and without an anal cell ; with the second branch of the second anal absent ; first anal present only apically ; cubito-anal cross vein complete or incomplete and joining cubitus to first anal. *Prosternum* (text-fig. 16) very short in front of anterior coxae ; process long and acute. Mesosternum with a deep and narrow groove for the reception of the

prosternal process, this groove being posteriorly very broad and nearly as broad as long where its posterior wall is formed by the mesosternum. Metasternum with a longitudinal impressed line. Abdomen with the sixth ventral segment externally visible. Legs with the front coxae transverse; with the externally visible part of the trochantin large. Claws without teeth. *Alimentary canal* with six Malpighian tubules. *Male reproductive system* with two long and narrow sperm tubes to each testis. The details of the internal anatomy are based on a single pupa in poor condition. The number of caeca on the anterior margin of the mid-gut, if any, could not be determined.

The wing venation is quite unlike that of any other Larini known to me, but perhaps, in the absence of an anal cell, it is nearest to *Phanocerus*, a genus with which it also agrees in having no accessory striae on the elytra and in possessing two sperm tubes to each testis. The structure of the larvae would place this genus very far from *Phanocerus* and near those genera having an anal cell in the hind wing.

All legs have at the ventral apex of the fourth tarsal segment a fine nearly erect seta which is about half as long as the fifth segment. This seta occurs in all species I have been able to examine, e.g. *gracilipes* Sharp, *caraiibus* Coquer., *thermarius* Coquer., *tarsalis* Hinton and *tibialis* Hinton, and is probably a good generic character. Certainly no other Larini I have seen have a similar seta.

GENOTYPE: *Hexanchorus gracilipes* Sharp.

The specific characters of most importance seem to be the following:

- (1) General proportions, length and breadth. It is particularly important to measure the length exactly, as this character is most useful in associating species with descriptions, there being but little intra-specific variation in size.
- (2) Punctuation of all parts of the dorsal surface. I have not considered the punctuation of the ventral surface, for it is generally concealed by the pubescence and besides there is an abundance of good specific characters.
- (3) Outline of the pronotum and the depth and general proportions of the impressions on its surface.
- (4) Proportion of scutellum and if flat or convex.
- (5) Form of elytral apices.
- (6) Shape of prosternum.
- (7) Shape of apical margin of fifth and sixth abdominal segments.
- (8) Structure of the abdominal spicule.
- (9) Secondary sexual characters. These are among the most highly specific characters I have been able to find.
- (10) Structure of the male genitalia. Here are found the most important specific characters, and no one should describe a new species without illustrating this organ.

The following secondary sexual characters have been observed in the species before me:

- (1) Female with the inner apices of the elytra turned up vertically (*gracilipes*).
- (2) Front tibia of the male slightly shorter and more curved than that of the female (*gracilipes*).
- (3) Male with the inner apex of the fifth segment of the front tarsi dilated (*tarsalis*).

- (4) Male with a fine, short, and nearly longitudinal carina on the inner apex of the middle tibia (*gracilipes*, *caraibus*).
- (5) Male with a fine tubercle on the inner apex of the middle and hind tibiae (*tarsalis*).
- (6) Male with a short and obliquely longitudinal tubercle on the inner apex of the hind tibiae (*tibialis*).
- (7) The disc of the metasternum and first three abdominal sterna is strongly concave in all males and convex in all females.
- (8) Apical margins of the fifth and sixth abdominal sterna always differently emarginate in the two sexes.
- (9) The structure of the abdominal spicule is completely different in the male and female.

This genus is widely distributed in Central and South America. One species occurs on Martinique and Guadeloupe.

Hexanchorus gracilipes Sharp.

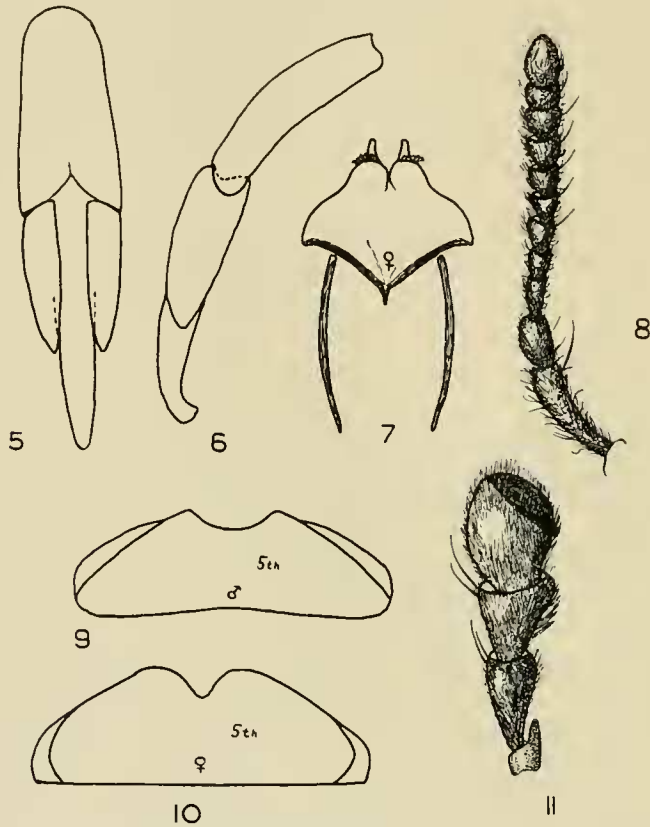
(Text-figs. 5-20.)

1882. *Hexanchorus gracilipes* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 128, t. 4, f. 7.

1937. *Hexanchorus gracilipes* Hinton, *Ent. mon. Mag.*, 73 : 96, 3 figs.

Male : Length, 3.5 mm.-4.0 mm. ; breadth (across elytral humeri), 1.32 mm.-1.55 mm. Elongate, subparallel, moderately convex. Dorsal surface clothed with fine, dark, suberect to erect, moderately dense hairs which are about 0.06 mm. long, and also densely pubescent with much finer and shorter hairs which are recumbent and usually greyish, though these often have a greenish iridescence. Ventral surface with both types of hairs longer, more like one another, and distinctly paler ; tibiae of middle legs pubescent only at extreme base. Cuticle black to rufopiceous ; two basal segments of antenna, mouthparts, trochanter, base of femora, all of tibiae, and claws paler. *Head* without distinct impressions. Anterior margin of clypeus truncate, with the angle on each side broadly rounded. Anterior margin of labrum shallowly and arcuately emarginate at middle, with the angle on each side broadly rounded. Eyes purplish in colour, narrowed posteriorly, and protected by an arch of long black setae which arise from the head near the dorsal and ventral sides of the eyes and meet above the eye at middle. Antenna as figured (text-fig. 8). Surface with two types of punctures as follows : coarse punctures (about 0.008 mm. in diameter) round and confluent to separated by once their diameters ; and fine punctures about a third as coarse and separated by one to three times their diameters. *Pronotum*, across broadest point, which is at basal two-fifths, broader than long (1.10 mm. : 0.85 mm.) and base broader than apex (1.07 mm. : 0.75 mm.). Pronotum with the impressions as figured (text-fig. 20) and with the surface punctate as head. Sharp (*loc. cit.*) said the pronotum had no punctures, but he can scarcely have looked at it very closely. *Elytra* more than three times as long as pronotum (2.80 mm. : 0.85 mm.), and with the broadest point across humeri being only slightly broader than broadest point at apical third. Inner side of apex of each elytron rounded. Lateral margins smooth. Humeri moderately gibbous. Sutural interval on posterior two-thirds feebly raised ; other intervals flat ; surface of intervals with the punctures no larger than finest of head and

pronotum and separated by two to ten times their diameters. Strial punctures on mid-discal region round to subquadrate, separated longitudinally by less than to once their diameters, and usually a third to half as broad as intervals; basally on disk they become finer and the intervals broader so that a ratio of one-eighth as broad here often prevails; at sides the punctures become slightly finer; towards apex they become much finer and the striae shallower, so that on apical sixth striae and punctures have nearly completely disappeared. *Scutellum*

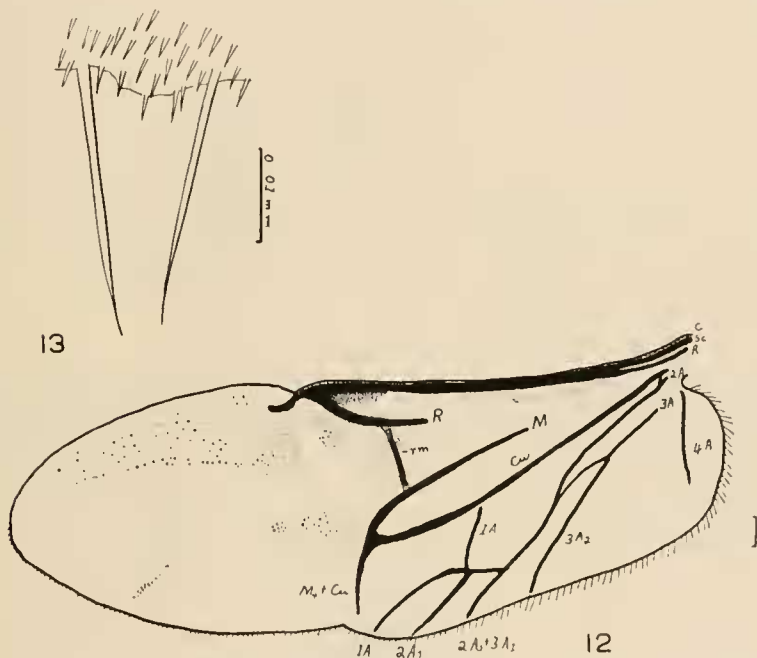


TEXT-FIGS. 5-11.—*Hexanchorus gracilipes* Sharp. (5) Dorsal view of male genitalia. (6) Lateral view of right side of male genitalia. (7) Female genitalia. (8) Antenna. (9) Ventral view of fifth abdominal sternite of male. (10) Ventral view of fifth abdominal sternite of female. (11) Maxillary palp.

slightly longer than broad (0.17 mm. : 0.15 mm.) and moderately convex, being distinctly elevated above the adjacent clytral intervals. *Prosternum* (text-fig. 16) with the process long. *Metasternum* concave, the concave portion broadening out posteriorly so that at posterior margin it embraces most of the disk; with an acute but low median longitudinal carina which extends from base forwards for about 0.12 mm. and from end of this carina a narrow, shallow, impressed line extends forwards, becoming narrower and shallower anteriorly so that it scarcely attains the anterior margin of the metasternum. Abdomen with the entire disk of the first two segments and the anterior half of the third strongly concave;

first segment with the discal carina extending to posterior fourth or fifth; apical margin of fifth and sixth as figured (text-figs. 9 and 15); spicule as figured (text-fig. 19). *Legs* with the front tibiae feebly curved inwards near apical third. Middle tibiae glabrous except for extreme base, and with a fine, short, nearly longitudinal carina on inner apex. *Genitalia* as figured (text-figs. 5, 6).

Female: Externally similar to male except as follows: (1) The inner apex of each elytron is turned upwards at right angles to the general surface; (2) front tibiae are slightly less curved than those of male; (3) middle tibiae without a carina on inner apex; (4) disc of metasternum much more feebly and less extensively concave; (5) disc of first three ventral abdominal segments convex,



TEXT-FIGS. 12, 13.—*Hexanchorus gracilipes* Sharp. (12) Hind wing. Venation after Forbes. (13) Microtrichia near inner apical margin of wing.

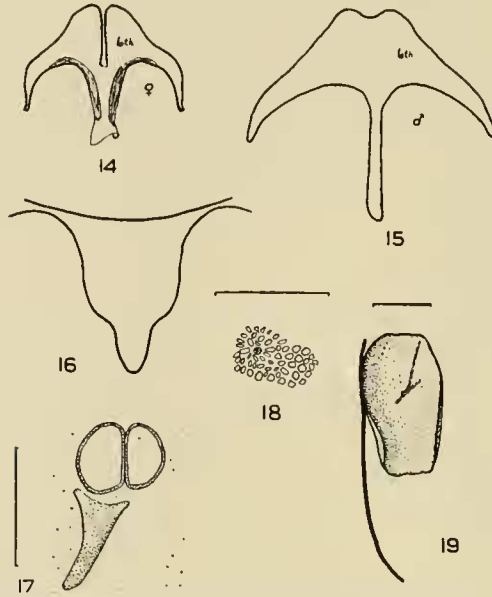
not concave; (6) apical margin of fifth abdominal segment as figured (text-fig. 10); (7) apical margin of sixth abdominal segment as figured (text-fig. 14); (8) spicule as figured (text-fig. 17).

The eggs are nearly round with a diameter of about 0.30 mm. The surface is densely reticulate throughout. The pattern near the micropyle is shown in text-fig. 18.

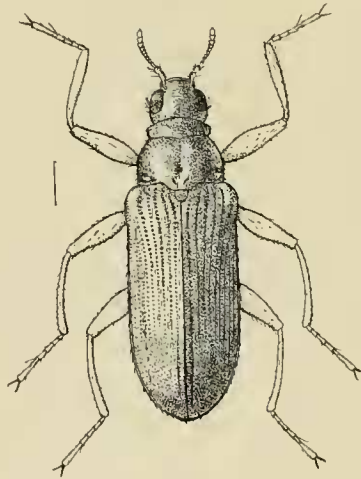
Type: ♂ in the collection of the British Museum (Nat. Hist.). MEXICO: Chinantla (Salle).

Specimens examined: Five with data as above. 784, MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. about 5600 ft., vi–vii. 1933 (*H. E. Hinton*, *R. L. Usinger*) and vi–vii. 1934 (*H. E. Hinton*); 160, in the same district but at Tejupilco, 3500–4000 ft., vii. 1934 (*H. E. Hinton*); 217, MEXICO: Estado de Morelos, Cuernavaca, alt. 4800 ft., vi. 1934 (*H. E. Hinton*). 1, PANAMA: Bugaba

(*Champion*) and 1, Chargres Basin, Upper Pequini Riv. (*A. H. Jennings*). 2, COSTA RICA: San Jose, La Caja, ii-vii. 1932 (*H. Schmidt*).



TEXT-FIGS. 14-19.—*Hexanchorus gracilipes* Sharp. (14) Ventral view of sixth abdominal sternite of female. (15) Same of male. (16) Prosternum. (17) Spicule of female. (18) Pattern on surface of egg near microphyle. (19) Spicule of male.



20

TEXT-FIG. 20.—*Hexanchorus gracilipes* Sharp illustrated from the type.

Variations: The variations in the large series before me are mainly confined to size and slight differences in punctuation. In many specimens the greenish iridescence of the fine hairs on the dorsal surface is not present. The series from

Cuernavaca is with few exceptions greyer than those from other localities, and the size appears to be very slightly (0.20 mm.) but constantly greater (this has not been verified statistically). A few individuals have the third elytral interval feebly convex in the discal region.

Comparative notes : The secondary sexual characters plus the structure of the male genitalia will readily separate the male from all other described species. This species is probably nearest to *H. tarsalis* Hinton, from which the female may be distinguished at once by the elevated apices of the elytra and the deeper emargination of the apex of the fifth abdominal sternite.

Biology : They are found in small to large streams (1-30 metres) on the downstream sides of stones, where they are often present in large numbers above the water level. The writer has netted over 300 at one time from the side of a large stone. They appear to be feeding on the algae growing near the water level on such stones, and with sudden rises in the water level they are occasionally submerged for a few seconds, but this apparently does not alarm them, for they remain clinging to the same spot on the stone. When submerged they are completely surrounded by a film of air.

When the larvae are mature they crawl up a stone and burrow under the algal or moss matting, often more than three feet above the water level. Under this matting they construct a small cell in which they pupate. While in the water the larvae feed on decaying vegetable material, as may be seen from an examination of their gut contents.

PUPAE.

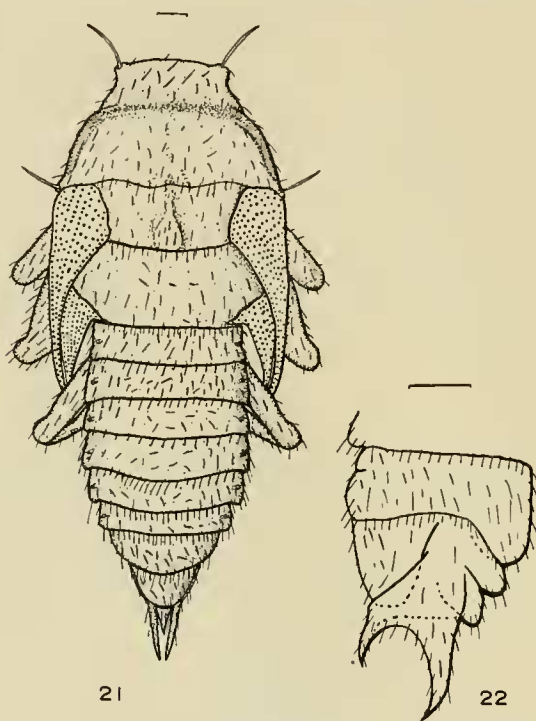
A single specimen was taken by peeling off the moss matting which was growing above the water level on a large stone in a torrential stream. The pupal cell was in the earth surrounding the roots of the moss, but the ventral side of the cell was formed by the surface of the stone. Since only a single pupa was taken it was allowed to mature for several days, and when it appeared the adult was about to emerge, it was preserved in spirit and determined beyond question as that of *H. gracilipes* by dissecting out the sclerotized parts of the male genitalia.

Description of Pupa of H. gracilipes Sharp.

(Text-figs. 21, 22.)

Male : Length, 4.25 mm. ; breadth (across broadest point which is at base of prothorax), 1.32 mm. *Head* completely concealed from above by the pronotum. At middle near anterior margin of frons with a feeble, transverse gibbosity which is 0.20 mm. long and has on each side an acute tubercle which is 0.075 mm. high. Surface sparsely pubescent with fine, erect, pale hairs which are 0.07 mm. to 0.12 mm. long and are moderately densely distributed on the epicranium, genae and frons, but form a dense transverse row near anterior margin of frons, clypeus and labrum. Antennae extend posteriorly and downwards to a point exactly opposite posterior margin of front coxae. *Pronotum* similar in shape and various impressions to that of the adult ; with two anterior and two posterior long stout spines as figured (text-fig. 21) ; surface clothed with hairs which are similar in length and density to those of the posterior region of the head. *Mesonotum* with a large oval gibbosity representing the scutellum beneath (text-fig. 21) on middle posterior margin, and from this gibbosity a fine carina extends along middle line to anterior margin. *Mesothorax* and abdominal

segments as figured; ninth at apex with a median dorsal and two lateral projections (text-figs. 21 and 22). Surface of these segments throughout pubescent as pronotum but slightly more finely and sparsely so. *Wings* with the anterior pair extending to ventral side, attaining middle of fourth abdominal segment, and near apex separated from each other by a distance equal to their greatest breadth; posterior wings similarly extending to ventral side but contiguous near apex and attaining middle of fifth abdominal segment. *Legs* with the front pair extending to posterior portion of metathorax and tarsi separated by half their own lengths from each other on the middle line of the body; second pair



TEXT-FIGS. 21, 22.—*Hexanchorus gracilipes* Sharp. (21) Dorsal view of pupa. (22) Left side of the end of the abdomen of the same.

extending to middle of first abdominal segment and with their claws contiguous; hind pair with the coxae, trochanters, base of femora, apex of tibiae and base of tarsi concealed by the hind wings; apical three segments of tarsi contiguous; claws attaining middle of sixth abdominal segment. *Abdominal spiracles* placed on dorso-lateral sides and opening at apices of small tubercles.

Specimen examined: MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. about 5600 ft., vii. 1934 (*H. E. Hinton*).

LARVAE.

The larva of *H. gracilipes* has been definitely determined as such, for the cast skin of the last instar larva was found in the same cell as the pupa. In 1937 three species of larvae which apparently belong to the genus *Hexanchorus* were collected in South America. Of these, one can be reasonably determined by

elimination and locality as that of *H. tibialis* Hinton. Of the two remaining, one is from French Guiana, a region from which until now no adults have been recorded, and the other was collected in Brazil without adults. The latter, which was collected in localities as far apart as 1000 miles, may be *H. thermarius* Coquer. or a new species. No exact locality record is extant for *thermarius*, but if it is ever collected in the Amazon basin it may be reasonably associated with this larva, which seems to be the common and possibly only one here. In addition to these I have been able to study the larvae of *H. tarsalis* Hinton collected by Dr. Fritz Plaumann in the same locality as the adult type. A key to the five species is given below, and the two undetermined species are included, for names can be assigned to them with reasonable certainty as soon as the adults are recorded from the same region. In no known case does the distribution of one species of *Hexanchorus* overlap that of another.

A KEY TO THE LARVAE OF THE SPECIES OF *Hexanchorus*.

1. Head with one ocellus on each side 2.
 Head with more than one ocellus on each side 3.
2. Mesothoracic and abdominal spiracles opening at the apices of very long and slender spines; ninth abdominal tergite strongly emarginate at apex; tergites of mesothorax and first two abdominal segments densely and evenly tuberculate. FRENCH GUIANA (St. Laurent du Maroni) *H. sp. ?*
 Mesothoracic and abdominal spiracles not opening on the apices of very long and slender tubercles; ninth abdominal tergite truncate at apex; mesothorax and first two abdominal segments with complete and transverse belts free of tubercles on anterior and middle part of each tergite. BRAZIL (Manaos, Belem) *H. sp. ?*
3. Head with six ocelli on each side. Mesothoracic and abdominal spiracles opening at the apices of large and conspicuous tubercles. CENTRAL AMERICA *H. gracilipes* Sharp.
 Head with five ocelli on each side 4
4. Mesothoracic and abdominal spiracles not opening on large tubercles. BOLIVIA (Yungas Valley) *H. tibialis* Hinton.
 Mesothoracic and abdominal spiracles opening at the apices of large and conspicuous tubercles. BRAZIL (Santa Catharina) *H. tarsalis* Hinton.

From a study of these five species a brief generic diagnosis may be made, since it is now possible to distinguish between those characters that are of specific and those that are of generic importance.

Generic Characters of Larvae of Hexanchorus.

Body parallel, cylindrical. *Head* when viewed dorsally exposed and not concealed by the pronotum; anterior margin between base of antenna and clypeus toothed; with one to six ocelli on each side. Antenna 3-segmented, not retractile. Mandibles of both sides similar and with three obtuse apical teeth; prosthema long, slender, and densely spinose. Maxilla with the palp 4-segmented and stipes showing no differentiation into a palpifer; galea and lacinia separate and apex of each densely spinose. Labium with the post-mentum

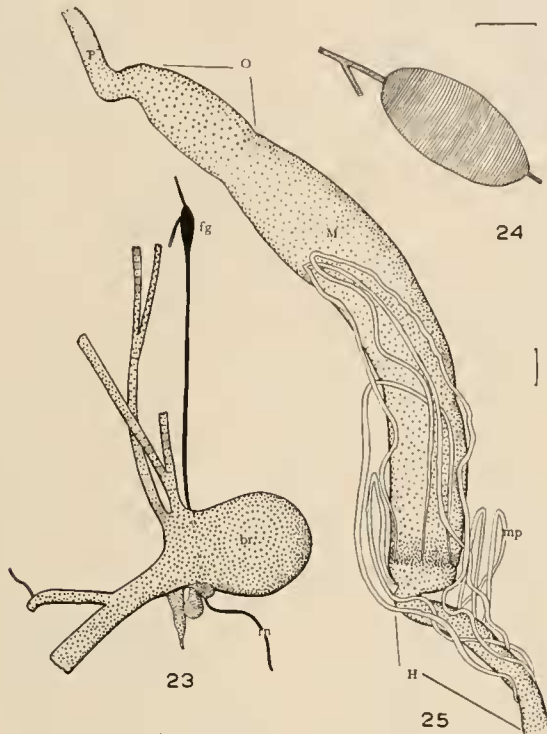
undivided and the submentomental muscles absent; labial palp 2-segmented and prementum with a palpiger. Gula well developed. *Prothoracic pleura* divided into three parts on each side, while those of the meso- and metathorax are divided into two parts. Prosternum divided into an anterior and a posterior sclerite; other thoracic segments with the sternum not divided. First six abdominal segments with pleura bounded by tergo- and sterno-pleural sutures; segments seven and eight forming complete sclerotized rings. Operculum with two strongly sclerotized claws attached to its dorsal membrane. Apex of ninth segment rounded to strongly emarginate. *Spiracles* present on mesothorax and first eight abdominal segments, and they may open at the level of the cuticle or on prominent spines or tubercles; sometimes they are present a short distance from the median line on each side and again in some species they are found only on the lateral margins. Tracheae with a number of well-developed air sacs or without any. Three tufts of retractile, anal, tracheal gills are present. *Alimentary canal* (text-fig. 25) with the six Malpighian tubules ending freely in the body cavity near the rectum. *Central nervous system* with three thoracic and eight abdominal discrete ganglia.

Description of Mature Larva of H. gracilipes.

(Text-figs. 23-47.)

Length, 5.1 mm.; breadth (across broadest point, which is at base of mesothorax), 1.5 mm. Elongate, subparallel, and cylindrical to subtriangular in cross section. Cuticle brownish; with the antennae, mouth-parts and legs paler brown to testaceous. *Head* slightly broader than long (0.65 mm. : 0.55 mm.); posterior margin broadly emarginate at middle; coronal suture short; frontal sutures beginning on posterior sixth of head and diverging forwards to meet anterior margin opposite base of antenna on each side; anterior margin between base of antenna and clypeus narrowly projecting forwards as far as the anterior margin of the clypeus. Cuticle sparsely pubescent with fine, erect hairs which are about 0.12 mm. long; finely and densely alutaceous throughout; anterior five-sixths set with round, convex tubercles which are about 0.04 mm. broad and are usually separated by less than to one and a half times their diameters; each tubercle with a coarse hairy seta which is at most slightly longer than the diameter of the tubercle from which it arises; dorsally with the basal sixth and ventrally with the basal fifth free of tubercles. Eyes of five large and one smaller and slightly ventral ocellus. Antenna (text-fig. 27) not retractile. Clypeus nearly as long as second segment of antenna; anterior margin feebly and broadly emarginate, nearly truncate, with the angle on each side broadly rounded. Labrum as figured (text-fig. 30); epipharynx entirely membranous. Mandible (text-fig. 28) with three, short, obtuse apical teeth; outer lateral side with a small hairy seta; prostheca (p) long and densely spinose. Maxilla (text-fig. 29) with the setae as figured. Labium (text-fig. 26) with the setae as figured. *Thoracic and abdominal tergites* for the most part sculptured as frontal region of head but with the tubercles slightly larger and also with two other types of tubercles as follows: (1) Median and lateral well-defined areas on thoracic and first six abdominal segments (text-fig. 34) with very dense tubercles (text-fig. 31) which are about half normal size; and (2) tubercles about three-fourths the size of the latter, nearly as dense, and occurring on irregular areas near the median line of the thoracic and first five abdominal segments. The sculpture of

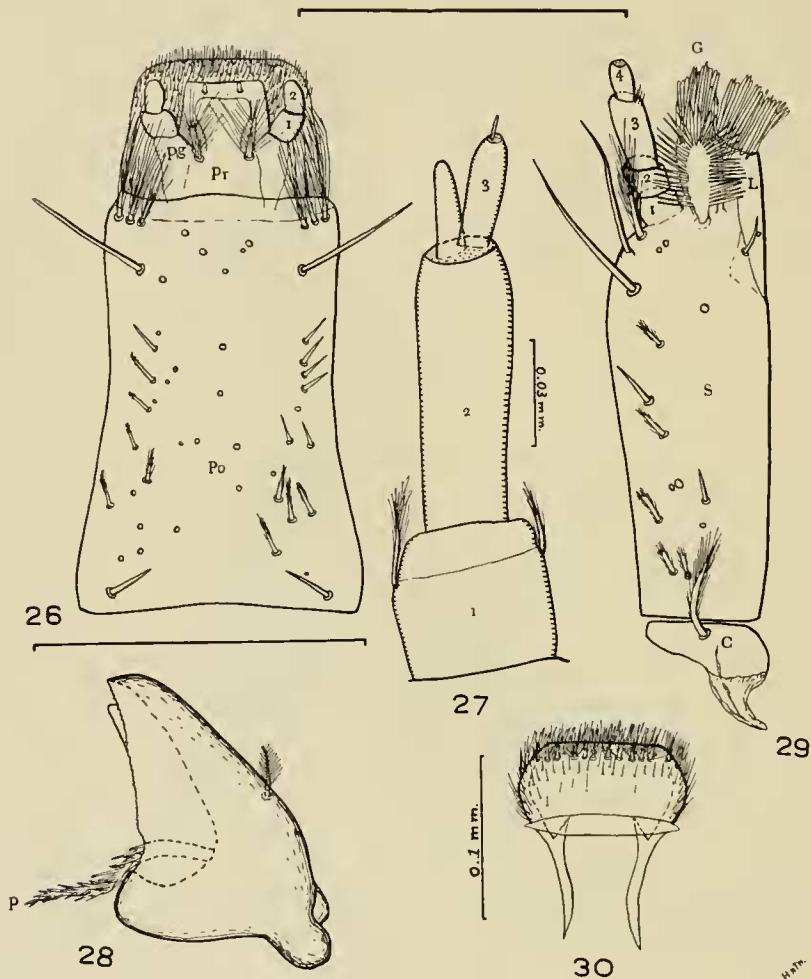
a section on the right side of the fifth abdominal segment is figured (text-fig. 36) ; posterior margin with a single row of tubercles (text-fig. 39) similar to the posterior row of all segments except ninth abdominal which has no special posterior row ; lateral margins of thoracic segments with two close and complete parallel rows of tubercles from which arise long, flat setae (text-fig. 40) ; lateral margins of first eight abdominal segments tuberculate as lateral margins of thorax but with the dorsal row of tubercles present only posteriorly ; ninth abdominal segment without a distinct lateral margin and with the sides throughout tuberculate as on dorsum. Thoracic and abdominal tergites gibbous and depressed



TEXT-FIGS. 23-25. (23) Brain of *Hexanchorus* sp. ? (24) Tracheal air sac of *Hexanchorus* sp. ? (25) Alimentary canal of *Hexanchorus gracilipes* Sharp. — (*br*) brain ; (*fg*) frontal ganglion of stomodeal nervous system ; (*H*) hind gut ; (*M*) mid-gut ; (*mp*) Malpighian tubule ; (*O*) oesophagus ; (*P*) pharynx.

as shown in text-fig. 32 ; ninth abdominal segment with the apex rounded (text-figs. 32 and 43). *Sternum* of thorax and first abdominal segment sclerotized as figured (text-fig. 41). First six abdominal segments with pleura bounded by tergo- and sterno-pleural sutures ; segments seven and eight forming complete sclerotized rings, though in some species there is a pale line on these two segments which is apparently the trace of a sterno-pleural suture. Cuticle tuberculate similarly to dorsum but with the tubercles slightly finer and without areas of fine, dense tubercles. Operculum (text-fig. 42) with two toothed claws attached to its dorsal membrane (text-fig. 47). *Legs* with the front pair shortest and the hind pair longest ; posterior legs sculptured similarly to front legs (text-fig. 35).

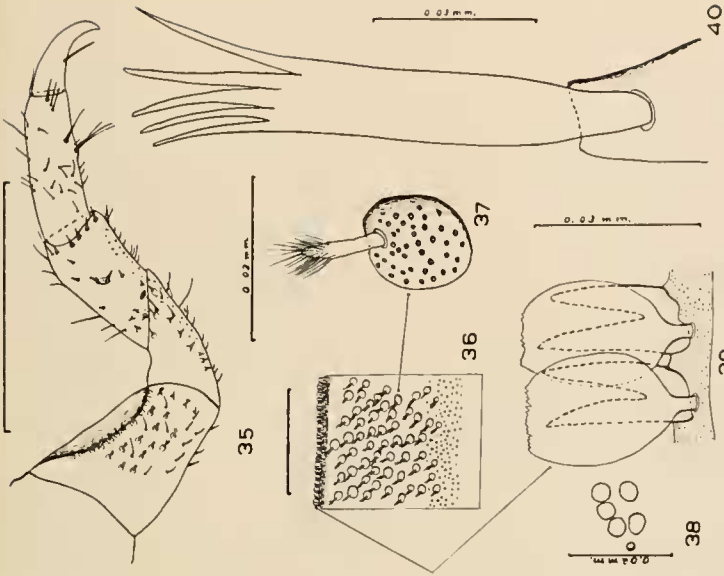
Spiracles opening on the apices of large tubercles which on the mesothorax are lateral on anterior third of segment and on first seven abdominal segments are laterally on posterior third, while on the eighth the tubercles are on the apices of the median gibbositities; spiracles all similar in structure to that of the last abdominal segment (text-figs. 45 and 46).



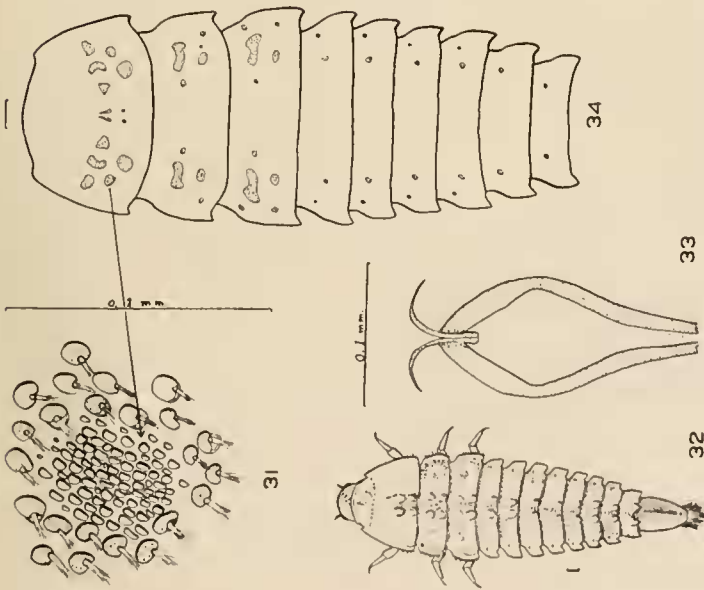
TEXT-FIGS. 26-30.—Larva of *Hexanchovius gracilipes* Sharp. (26) Ventral view of labium. Setae of apical portion of the prementum are only approximately correct. (27) Antenna. (28) Ventral view of left mandible. (29) Ventral view of right maxilla. Apical spines of galea and lacinia only approximately correct. (30) Dorsal view of labrum with the setae drawn to give the general appearance.

Specimens examined: MEXICO: 14, Dist. de Temascaltepec, Real de Arriba, alt. 6000-7000 ft., Temascaltepec, alt. 5600 ft., and Tejupilco, alt. 3500-4000 ft., all in vi-vii, 1934 (*H. E. Hinton*); 12, Estado de Morelos, Cuernavaca, alt. 4, 800 ft., vi, 1934 (*H. E. Hinton*).

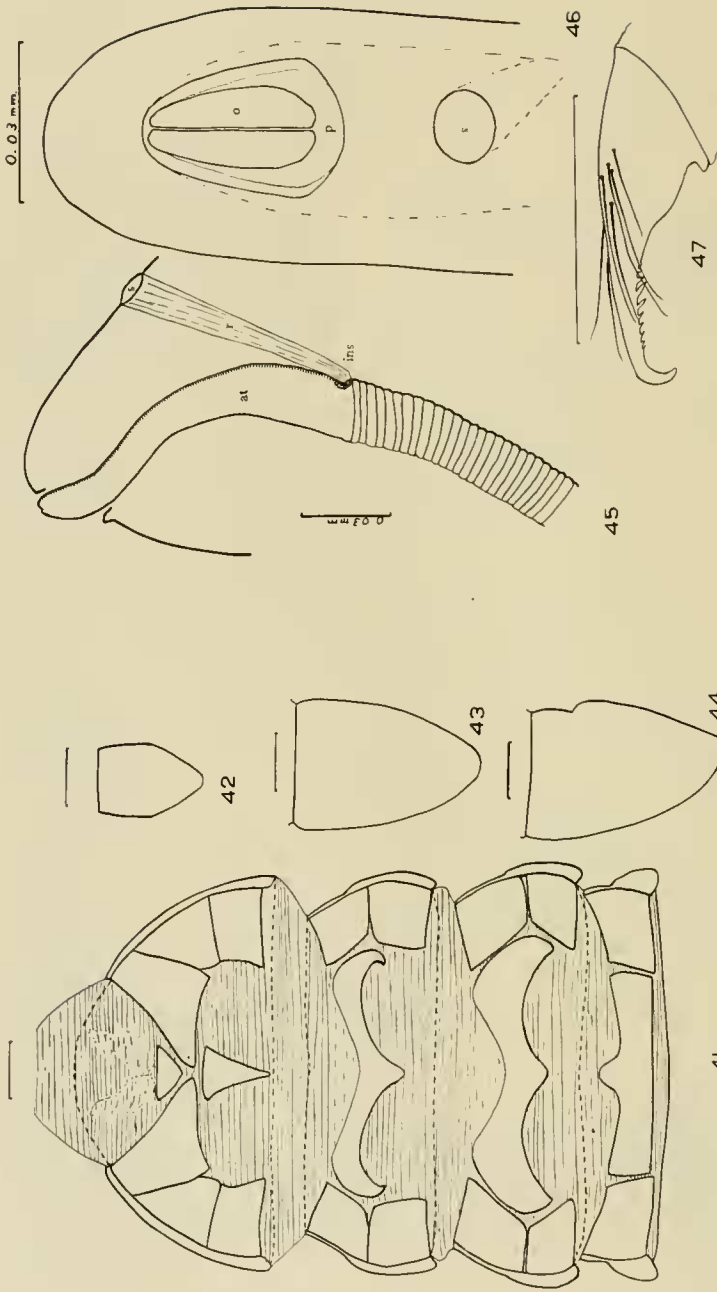
All the larvae before me are apparently mature.



TEXT-FIGS. 35-40.—Larva of *Hexanchorus gracilipes* Sharp. (35) Posterior outer view of right front leg. (36) Left side of the middle of fifth abdominal tergite. (37) Enlarged view of one of the tubercles of the fifth abdominal tergite. (38) Eye to show arrangement of ocelli. (39) Part of the posterior marginal row of setae of the fifth tergite. (40) Seta from lateral marginal row of mesothorax.



TEXT-FIGS. 31-34.—Larva of *Hexanchorus gracilipes* Sharp. (31) Enlarged portion of tuberculate area of pronotum. (32) Dorsal view of larva to show general appearance. (33) Dorsal view of oesophageal sclerite. (34) Dorsal view of thorax and first six abdominal segments to show the distribution of the densely tuberculate areas.



TEXT-FIGS. 41-47.—Larva of *Hexanchorus gracilipes* Sharp. (41) Ventral view of thorax and first abdominal segment to show sclerites. (42) Operculum. (43) Dorsal view of ninth abdominal segment. (44) Left lateral view of same. (45) Lateral view of last abdominal spiracle. (46) Dorsal view of same. (47) Dorsal view of right opercular claw. (at) atrium; (ins) inner scar; (p) peritreme; (r) remnant of preceding spiracle; (s) outer scar of preceding spiracle; (o) opening to atrium.

TEXT-FIGS. 41-44.—Larva of *Hexanchorus gracilipes* Sharp. (41) Ventral view of thorax and first abdominal segment to show sclerites. (42) Operculum. (43) Dorsal view of ninth abdominal segment. (44) Left lateral view of same.

PHANOCERUS Sharp.

1882. *Phanocerus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 128.

1896. *Phanocerus* Grouvelle, *Bull. Soc. ent. Fr.* : 78.

Body elongate, subparallel; clothed for the most part with moderately long and dense, usually recumbent hairs. *Hcad* when seen from below not capable of being retracted into the prothorax beyond the base of the prementum. Antennae as figured (text-fig. 54) with the last six segments forming a compact club. Mandible with two acute apical teeth; with a well-developed but entirely membranous prostheca. Maxillary palp (text-fig. 53) 4-segmented and stipes with a well-developed palpifer; galea and lacinia separate and each densely spinose. Labial palp (text-fig. 52) 3-segmented and prementum with a well-developed palpiger. Mentum shorter and narrower than submentum; submentum (text-fig. 55) strongly concave posteriorly and at middle forming a slight depression which is partly under the anterior margin of the gula. *Pro-notum* (text-fig. 56) with a broad longitudinal impression on each side, which anteriorly turns outwards to meet the lateral margin at apical half. *Elytra* punctate and striate. Without accessory striae and without longitudinal carinae. Hind wing (text-fig. 57) without an anal cell or radial cross vein; with the first branch of the second anal absent; first anal very short, present only distally and not connected to cubito-anal cross vein; cubito-anal cross vein joining second anal to cubitus. *Prosternum* moderately short in front of the anterior coxae; process long and acute. Mesosternum anteriorly with a narrow groove for the reception of the prosternal process; this groove merges posteriorly into a larger and deeper depression the posterior margin of which is formed by the metasternum. Metasternum with a complete longitudinal impressed line. Abdomen with the sixth ventral segment not externally visible. *Legs* with the anterior trochantin visible externally only if coxae are rotated caudally. Claws without teeth. *Alimentary canal* (text-fig. 58) with eight caeca on the anterior margin of the mid-gut. Hind gut with six Malpighian tubules which extend forwards, often as far as the prothorax, and end freely in the body cavity near the rectum. *Male reproductive system* (text-fig. 60) with two sperm tubes to each testis, and with the testes always in the abdomen, seldom being as far forwards as the first segment; vas deferens with the proximal ectodermal part swollen to serve as vesiculae seminalis which are connected to the ejaculatory duct proximally to the two pairs of accessory glands. Accessory glands with the median pair dorsal and much shorter than the slightly ventral and lateral pair. Female reproductive organs (text-fig. 59) with nine egg tubes to each ovary. Spermathecal duct opening into bursa copulatrix near base. *Central nervous system* (text-fig. 61) with the thoracic ganglia not fused and with the first abdominal ganglion fused to the third thoracic, third to fourth discrete, and five to eight partly fused together. Stomodaeal nervous system with the occipital ganglion unpaired (text-fig. 61).

GENOTYPE: *Phanocerus clavicornis* Sharp.

The internal anatomy of two species was studied, a new one from Bolivia and *P. congener* Grouvelle from Trinidad. The new species is illustrated. Both agree in all essential details. The relative size of both reproductive systems, though particularly that of the male, differs enormously according to the sexual phase of the individual.

This genus is not close to any other in the Larini, though this is not so evident from the structure of the adults, which in many ways is close to *Hexanchorus*,

as from that of the larvae. The larvae are very different from all known larvae of the tribe, but very close to those of *Phanoceroides* Hinton (Elmini).

The species are widely distributed in America, including the West Indies. The most northern record is that of *Phanocerus clavicornis* found in Texas.

Phanocerus clavicornis Sharp.

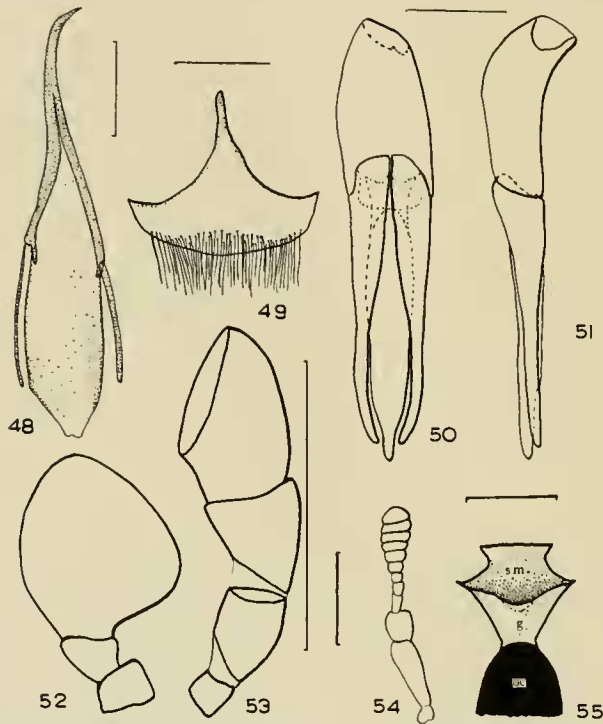
(Text-figs. 48-61.)

1882. *Phanocerus clavicornis* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 129, t. 4, f. 8.

1911. *Phanocerus clavicornis* Schaeffer, *J. N.Y. ent. Soc.*, 19 : 118.

1937. *Phanocerus clavicornis* Hinton, *Ent. mon. Mag.*, 73 : 95.

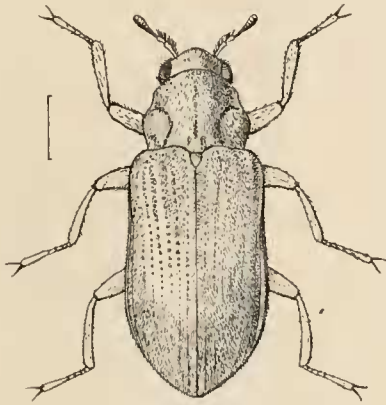
Male: Length, 2.0 mm.-3.0 mm.; breadth (across humeri which is the broadest point), 0.85 mm.-1.1 mm. Elongate, subparallel, moderately convex.



TEXT-FIGS. 48-55.—*Phanocerus clavicornis* Sharp. (48) Spicule of male. (49) Ventral view of sixth abdominal sternite of male. (50) Dorsal view of male genitalia. (51) Right lateral view of same. (52) Labial palp. (53) Maxillary palp. (54) Antenna. (55) Submentum (*sm*) and gula (*g*).

Dorsal surface clothed with partly erect brownish hairs which are about 0.05 mm. long and are usually separated from each other by about a third of their lengths; also more densely clothed with hairs which are finer, about a third as long, and frequently in certain lights golden and shining. Ventral surface for the most part with only the longer hairs which are here recumbent and frequently so dense that the cuticle beneath cannot be seen. Cuticle shining and rufo-piceous to pale brown; mouth-parts, basal segments of antennae, and legs paler. *Head* without distinct impressions. Eyes narrowed posteriorly; margins around eyes

laterally and posteriorly with very long, stout, black setae which curve across the eye and generally meet about middle over eye. Antenna as figured (text-fig. 54). Surface with punctures which are usually round, about 0.010 mm. broad, and are contiguous to separated by once their diameters. Clypeus with the anterior margin truncate and the angle on each side broadly rounded. Labrum with the anterior margin feebly, broadly, arcuately emarginate, and with the angle on each side broadly rounded; anterior margin except at middle with a dense fringe of long testaceous hairs and on each side just behind angle with a tuft of longer and denser hairs. Gula and submentum as figured (text-fig. 55); mentum with the anterior margin truncate or at most very feebly rounded. *Pronotum* across broadest point, which is at basal two-fifths, broader than long (0.92 mm. : 0.77 mm.) and base broader than apex (0.87 mm. : 0.60 mm.). Pronotum as figured (text-fig. 56); surface similarly but more sparsely punctate



56

TEXT-FIG. 56.—*Phanocerus clavicornis* Sharp.

than head. *Elytra* between humeri and apical two-fifths nearly parallel. Humeri feebly gibbous. Apices conjointly, feebly rounded but the apex of each elytron is itself feebly rounded. Lateral margins smooth. Intervals flat and surface of each punctate as pronotal disk. Striae feebly impressed but narrower and slightly deeper towards apex; strial punctures on disc round to subquadrate, separated longitudinally by about their diameters, and from a half to a third as broad as intervals; towards sides these punctures become a little finer, but towards apex much finer so that on apical fourth they are seldom as much as one-third as broad as an adjacent interval. *Scutellum* flat, broader than long (0.12 mm. : 0.10 mm.), with the base broadly arcuate and posteriorly coming to a rounded point. *Prosternum* moderately short in front of anterior coxae. *Metasternum* with an impressed median longitudinal line which suddenly broadens out and becomes deeper near anterior margin; anterior margin on each side projecting slightly, but distinctly over depression formed by the median line. Abdomen with the apical margin of the fifth sternite broadly rounded. Sixth sternite as figured (text-fig. 49). Spicule as figured (text-fig. 48). *Genitalia* as figured (text-figs. 50, 51).

Female: Externally similar to male except as follows: (1) The posterior

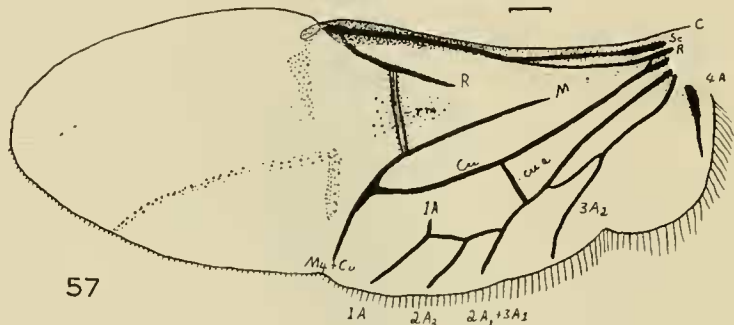
projection of the concealed sixth abdominal sternite is much longer; (2) the spicule of the male has no homologous sclerotized part in the female. Eggs are oval to nearly round, and the surface is marked with a close network of cells which are usually round.

Type: In the British Museum (Nat. Hist.). GUATEMALA: Vera Paz, Corban (*Champion*).

Specimens examined: 6, with same data as above, 2, MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. 6000–7000 ft., vii. 1933 (*H. E. Hinton, R. L. Usinger*); 2, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*). 160, BRAZIL: Santa Catharina, Nova Teutonia, 1934–1935 (*F. Plaumann*).

Other records: This species has been recorded from Texas by Schaeffer (1911).

Variations: The absolute length and breadth in the series before me vary very much. The elytral stria punctures in some rare individuals may be only two-thirds as large and dense as in the specimen described.



TEXT-FIG. 57.—Wing of *Phanocerus clavicornis* Sharp. Venation after Forbes.

Comparative notes: This is the only genus known to me in the Larini in which there are apparently no differences in the structure of the male genitalia of the different species. My figures of the male genitalia of *P. clavicornis* will apply equally well to seven species before me.

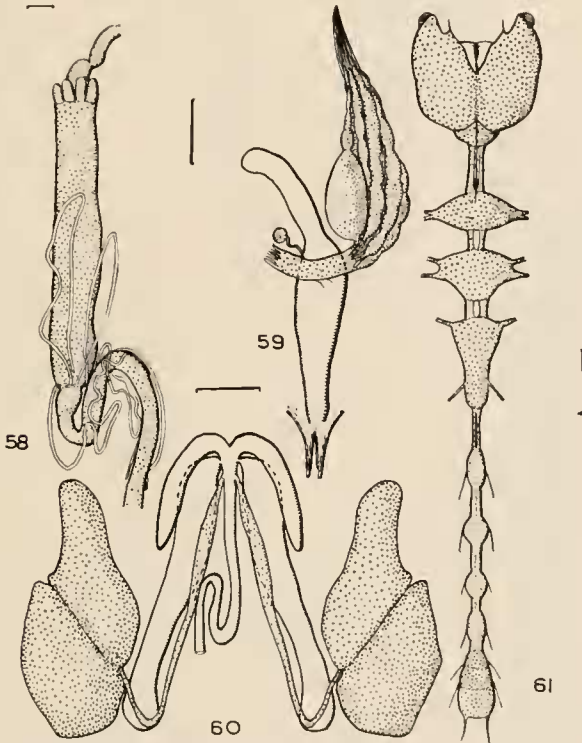
There have been two other species described from continental America, one from Columbia and the other from Argentina, but both are known to me only from descriptions which are so inadequate that I am unable to say in what manner, if any, they differ from *P. clavicornis*.

Biology: This species is generally found feeding on algae growing above the water level on stones and sticks either in the stream or lying along the margin. It may enter the water to oviposit, but is not generally found below the water level as is the allied *Phanoceroidea*.

LARVAE.

By elimination and according to locality the larvae of several species of *Phanocerus* have been associated with their adults. Although no evidence as conclusive as breeding is available, I regard the generic determination of these larvae as fairly certain for the following reasons: (1) the distribution of the larvae exactly coincides with that of the adults over North and South America; (2) in Central Mexico, the Yungas Valley of Bolivia, and Trinidad, B.W.I., where

I have made very large collections of the Elmidae, the larvae of all other genera (except in Mexico where the larvae of *Xenelmis* and *Austrolimnius* are still unknown) have been determined (those of *Xenelmis* and *Austrolimnius* must be too small to be confused with *Phanocerus*); (3) the mature larva is of a size to produce an adult equal in size to *Phanocerus*; and (4) in the streams about Manaos, Brazil, *Phanocerus* seems to be replaced by the closely allied genus *Phanoceroidea*, and the larvae of the latter are very nearly related to the larvae I consider to belong to *Phanocerus*.



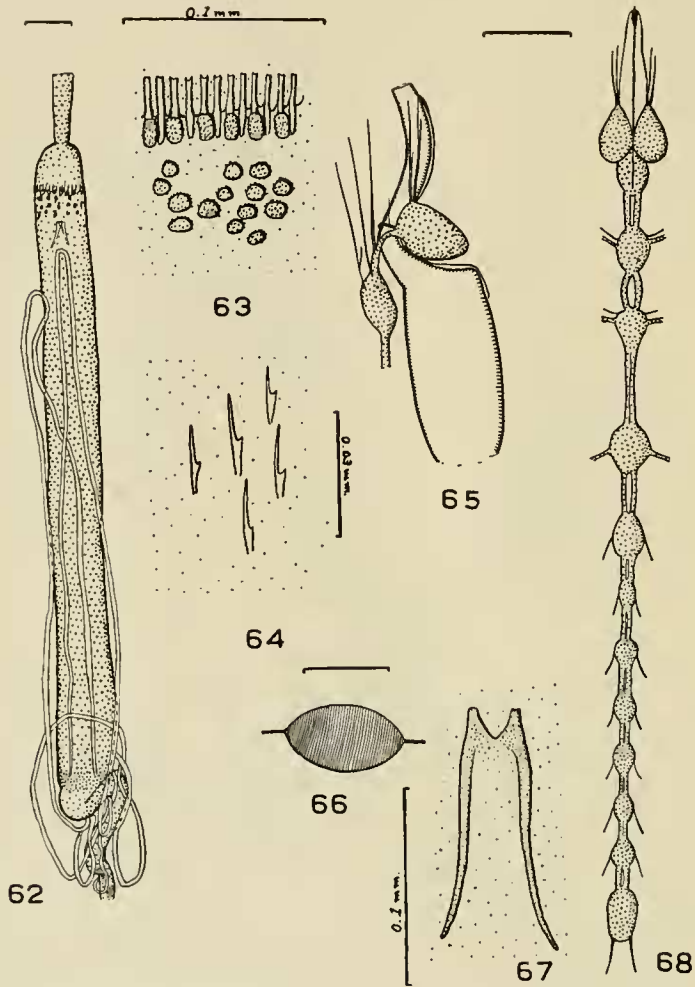
TEXT-FIGS. 58-61.—*Phanocerus clavicornis* Sharp. (58) Alimentary canal. (59) Female reproductive system. (60) Male reproductive system. (61) Central and stomodeal nervous systems.

From a study of the larvae before me, it has been possible to draw up a brief generic characterization of *Phanocerus*.

Generic Characters of Larvae of Phanocerus.

Flattened, subparallel. *Head* when viewed dorsally exposed and not concealed from above by the pronotum. With one ocellus on each side. Antenna 3-segmented, not retractile. Clypeus completely fused with the frons. Mandibles of both sides similar and with three subacute apical teeth; prostheca long, slender and densely hairy. Maxilla with the palp 4-segmented and stipes showing no differentiation into a palpifer; galea and lacinia separate and apex of each densely spinose. Labium with the postmentum undivided; palp 2-segmented, prementum without a palpiger. *Prothoracic pleura* divided into two parts and with the anterior part meeting on the middle line. Meso- and metathoracic pleura

divided into two parts on each side. First eight abdominal segments with pleura bounded by tergo- and sterno-pleural sutures. Operculum with two strongly sclerotized claws attached to its dorsal membrane. Apex of ninth segment rounded or strongly emarginate. *Spiracles* annular and biforous; present on mesothorax

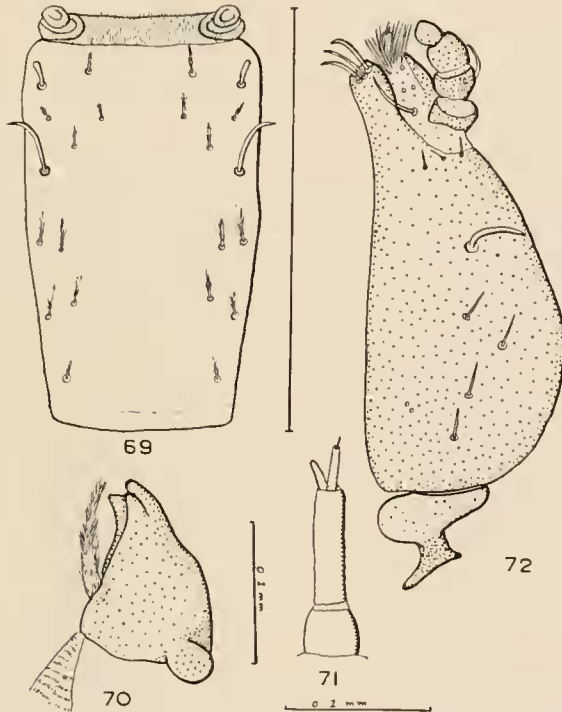


TEXT-FIGS. 62-68.—Larva of *Phanocerus clavicornis* Sharp. (62) Alimentary canal. (63) Oesophageal ring of tubercles and spines. (64) Portion of oesophagus anterior to ring to show shape and distribution of spines. (65) Left lateral view of brain. (66) Tracheal air sac. (67) Oesophageal sclerite. (68) Dorsal view of central and stomodeal nervous systems.

and first eight abdominal segments and opening at the cuticle level or on the apices of small tubercles. Tracheae with a number of well-developed air sacs. Three tufts of retractile, anal, tracheal gills are present. Alimentary canal with a dorsal oesophageal sclerite and anterior to this with a complete ring of spines and tubercles. With six Malpighian tubules which end freely in the body cavity generally near the rectum. *Central nervous system* (text-fig. 68) with three thoracic and eight abdominal discrete ganglia.

Description of Mature Larva of P. clavicornis.
(Text-figs. 62-83.)

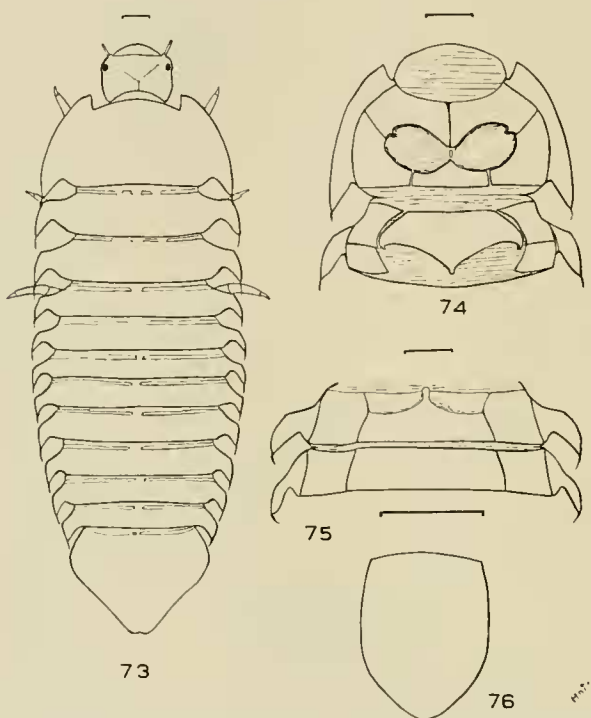
Length, 5.0 mm.; breadth (across broadest point which is near base of metathorax), 1.5 mm. Cuticle brownish-testaceous to brown. *Head* rectangular, longer than broad (0.50 mm. : 0.42 mm.); coronal suture straight and 0.22 mm. long; frontal suture extending nearly in a straight line on each side to margin of head opposite base of antenna. Cuticle on basal belt nearly as long as epicranial



TEXT-FIGS. 69-72.—Larva of *Phanocerus clavicornis* Sharp. (69) Ventral view of labium. Setae of prementum are only approximate. (70) Ventral view of left mandible. (71) Dorsal view of right antenna. (72) Ventral view of left maxilla. Spines on apex of galea are only approximately correct.

(coronal) suture not punctate, elsewhere with round punctures which are about 0.013 mm. broad and are separated usually by less than to once their diameters; from these punctures arise fine setae which are only slightly longer than the diameters of their respective punctures. With a single ocellus on each side. Antenna as figured (text-fig. 71). Clypeus fused to the front of the head and fronto-clypeal suture not visible even when the head is cleared and stained. Labrum transverse (0.16 mm. : 0.10 mm.); anterior margin feebly arcuate and with the angle on each side broadly rounded; epipharynx smooth. Mandible (text-fig. 70) with three subacute apical teeth; outer lateral side apparently without setae; with a long, narrow, slender, and hairy prosthema. Labium with the setae as figured (text-fig. 69). Maxilla with the setae as figured (text-fig. 72). *Thoracic* and *abdominal terga* with proportions as shown in text-fig. 73. Surface throughout punctate as frontal region of head but with the punctures slightly

larger and sparser; anterior part of each segment except pronotum with a transverse row of acute tubercles and large flat setae (text-figs. 79 and 81); a belt anterior to this is always finely and transversely rugose (text-figs. 79 and 82); at middle each row is interrupted by a space of about 0.07 mm. to 0.10 mm., and this row is also interrupted laterally on meso- and metathorax (text-fig. 73); at the posterior lateral apex of each segment is a very long and narrow seta (text-fig. 83); lateral ventral margins of each segment have a single row of seta (text-fig. 80). The posterior margin of each segment except ninth has a complete row of large,

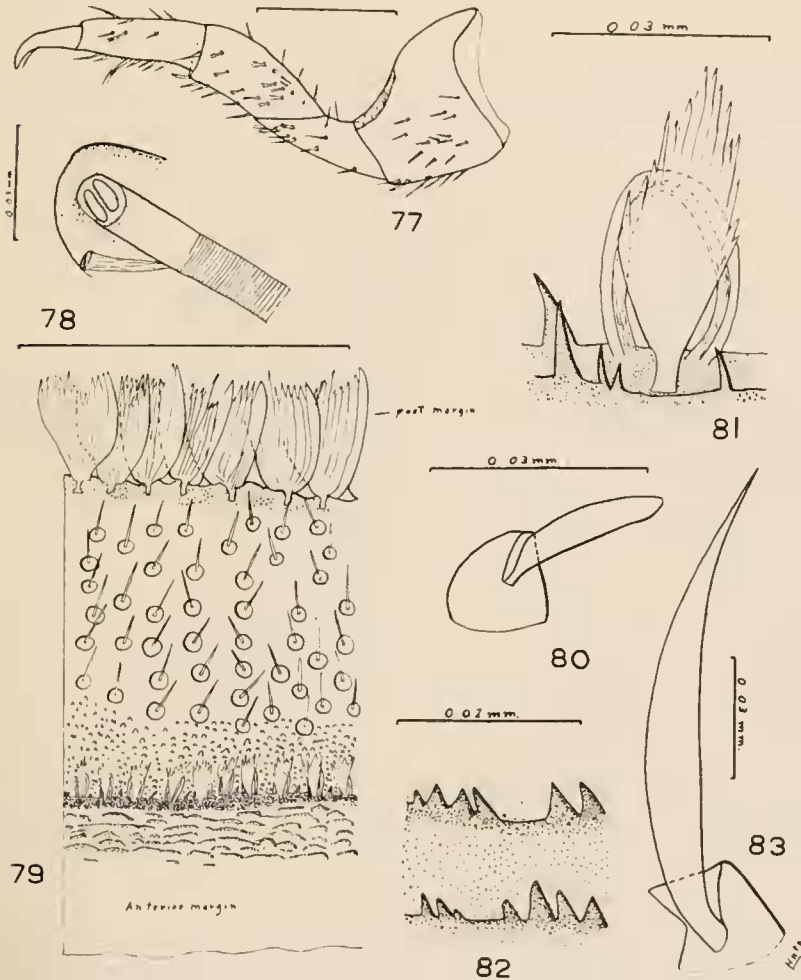


TEXT-FIGS. 73-76.—Larva of *Phanocerus clavicornis* Sharp. (73) Dorsal view of larva to show general shape. (74) Ventral view of pro- and mesothorax to show sclerites. (75) Ventral view of first two abdominal segments to show sclerotization. (76) Operculum.

flat, partly overlapping setae (text-fig. 79). *Sternum* of pro- and mesothorax sclerotized as figured (text-fig. 74); sternum of metathorax similar to that of mesothorax. First two abdominal sterna as figured (text-fig. 75); sterna of abdominal segments three to eight sclerotized similarly to that of second; ninth sternum with an apical operculum (text-fig. 76) which has attached to its dorsal membrane two well sclerotized claws. Surface of sterna of thoracic and abdominal segments finely and sparsely setose, but anterior third of abdominal pleura with a transverse row of larger and denser setae. *Legs* all fairly close in size and chaetotaxy to front leg (text-fig. 77). *Spiracles* opening laterally on mesothorax and first eight abdominal segments; all similar to that of fifth abdominal segment (text-fig. 78); with the cuticle around each of the spiracles slightly elevated but not forming well-developed tubercles. On each side of the gut there are seven tracheal air sacs (text-fig. 66) which occupy a position from first to sixth abdominal

segments. *Alimentary canal* as figured (text-fig. 62). *Central nervous system* as figured (text-fig. 68).

Immature stages: Before me are larvae representing at least two earlier instars, but these apparently differ only in size from the mature larvae.



TEXT-FIGS. 77-83.—Larva of *Phanocerus clavicornis* Sharp. (77) Anterior face of right front leg. (78) Fifth abdominal spiracle. (79) Third abdominal tergite on right side of middle line. (80) A seta of the ventral and lateral rows. (81) Flat seta of anterior row of third tergite. (82) Section of anterior rugose belt of third tergite. (83) Seta of posterior lateral apex of third tergite.

Biology: The larvae are found in small to large streams (about 1-30 metres) of fast and clear water. They seem to prefer the swifter parts of the streams. Examination of the gut contents of a number of specimens seems to show that they are living on algae (diatoms, etc.).

Specimens examined: 50, MEXICO: Estado de Morelos, Cuernavaca, alt. 4800 ft., vi.1934 (H. E. Hinton); 32, MEXICO: Dist. de Temascaltepec, alt.

3500-7000 ft., vi-vii. 1933 (*H. E. Hinton, R. L. Usinger*) and vi-vii. 1934 (*H. E. Hinton*); 7, GUATEMALA: Escuintla, El Salto, 1100 ft., 1934 (*F. X. Williams*).

THE MEXICAN ELMINI.

TOLRIOLUS, gen. n.

Body subparallel. Non-tomentose areas clothed with sparse and short, recumbent hairs; fine scale-like or hairy tomentum confined to the following areas: (1) genae; (2) epipleura; (3) hypomera; (4) sides of prosternum, mesosternum, metasternum, and abdominal sternites; and (5) most of femora. *Head* when seen from below capable of being retracted so that none of the mouth-parts is visible. Antennae 11-segmented. Mandibles with three blunt apical teeth; prosthema entirely membranous and with numerous fine spines or hairs apically. Maxilla with the palp 4-segmented (text-fig. 87) and stipes with a well-developed palpifer; galea and lacinia separate and apex of each spinose. Labium with the palp 3-segmented and prementum without a distinct palpiger. Mentum transverse and as broad as, but only half as long as, submentum. Gula at anterior margin three-fifths as broad as submentum, with the sides converging so that at posterior margin it is only half as broad as submentum, and about a fifth longer. *Pronotum* with the anterior margin moderately arcuate at middle and on each side behind eye before apical angle deeply and broadly sinuate; base broadly and moderately deeply sinuate on each side and feebly rounded in front of scutellum. *Pronotum* with a sublateral carina on each side extending from near base nearly to anterior margin; disk without distinct impressions. *Elytra* punctate and striate; each elytron with a single prominent sublateral carina on eighth interval. Hind wing (text-fig. 93) without a radial cross vein or an anal cell; first anal absent; second anal with the second branch absent; third anal with the second branch absent; fourth anal well-developed; and cubito-anal cross vein complete and joining cubitus to second anal. *Prosternum* very long in front of anterior coxae; process as figured (text-fig. 91). *Mesosternum* with a broad and moderately deep groove for the reception of the prosternal process. *Metasternum* with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae rounded and the trochantin completely concealed by the hypomera and sternum. Claws each with a large and acute sub-basal tooth (text-fig. 90).

GENOTYPE: *Limnius ungulatus* Hinton.

No properly preserved specimens have been available for a study of the internal anatomy.

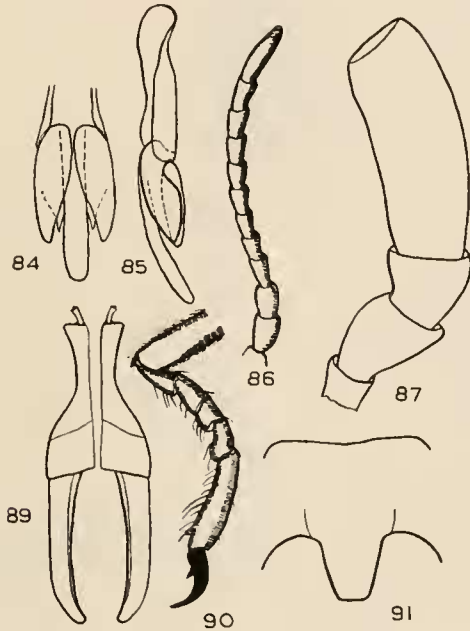
T. ungulatus has recently (Hinton, 1936) been referred to the genus *Macronychooides* Champion (1923), but though *Tolriolus* is most closely related to this genus, it may be distinguished as follows: (1) the genae are tomentose; (2) the hypomera are tomentose; (3) the pronotum has a distinct sublateral carinae, whereas in *Macronychooides* there is no trace of carinae here; (4) each elytron has a sublateral carina on eighth interval, whereas in *Macronychooides* the lateral intervals of each elytron are flat; (5) the first anal of the hind wing is absent, whereas in *Macronychooides* it is present; (6) the prosternum in front of the anterior coxae is long (equal to about one and a half times the greatest breadth of the front coxae), whereas in *Macronychooides* it is here short (equal to about a third of the greatest breadth of the front coxae); and (7) the mesosternum has the groove for the reception of the prosternal process broad, while in *Macronychooides* it is narrow.

Tolriolus ungulatus (Hinton).

(Text-figs. 84-93.)

1934. *Limnius ungulatus* Hinton, *Rev. Ent., Rio de J.*, 4 (2) : 200.1936. *Macronychoides ungulatus* (Hinton), *Trans. R. Ent. Soc. Lond.*, 85 (18) : 428, figs. 27-29; pl. 1, fig. 4.

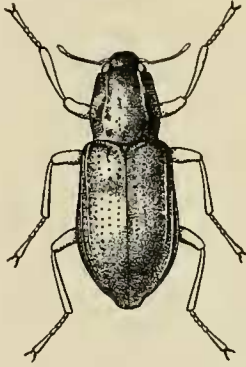
Male : Length, 2.12 mm.-2.37 mm. ; breadth, 0.95 mm.-1.12 mm. Cuticle shining and black ; basal three to five segments of antennae, mouth-parts, and legs rufo-piceous. *Head* without distinct impressions ; surface with round, low, often indistinct granules which are slightly finer than facets of eyes or about



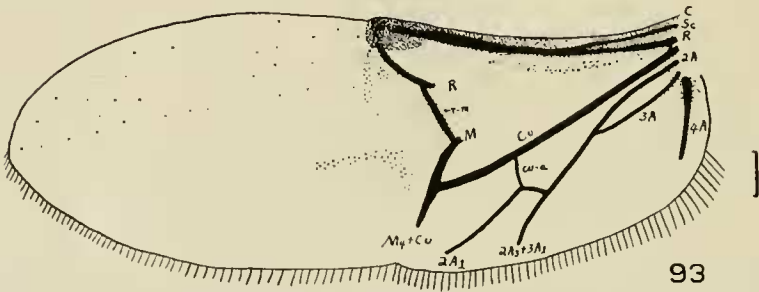
TEXT-FIGS. 84-91.—*Tolriolus ungulatus* Hinton. (84) Dorsal view of male genitalia. (85) Left lateral view of same. (86) Antenna. (87) Maxillary palp. (88) Female genitalia. (89) Tarsus of hind leg. (90) Prosternum.

0.012 mm. broad and are separated by two to four times their diameters ; surface between granules sparsely to densely microscopically alutaceous. Clypeus with the fronto-clypeal suture straight and indistinct ; anterior margin broadly, arcuately and deeply emarginate and with the angle on each side obtusely rounded ; surface sculptured as head. Labrum with the anterior margin nearly truncate and the angle on each side broadly rounded ; surface alutaceous as clypeus, without granules, at middle on anterior third with a few punctures which are about as coarse as granules of head, and on each side with a few fine, recumbent, testaceous setae which are about 0.04 mm. long. *Pronotum* across broadest point, which is at basal two-fifths, slightly broader than long (0.72 mm. : 0.70 mm.) and base broader than apex (0.63 mm. : 0.45 mm.). Sublateral carinae and impressions as figured (text-fig. 92). Surface with the apical third between sublateral carinae with fine (about 0.10 mm. broad), irregularly shaped, obscure punctures which are usually separated by two to four times their diameters and

surface between these punctures only sparsely alutaceous; surface on basal two-thirds of disk with low, round granules which are about as coarse or slightly coarser than facets of eyes and are separated by one to four times their diameters; surface between these punctures for the most part contiguously to confluent punctate with very fine punctures (about 0.007 mm. broad); surface between



92



93

TEXT-FIGS. 92, 93.—*Tolviolus ungulatus* Hinton. (92) Adult to show general appearance. (93) Hind wing. Venation after Forbes.

lateral margins and sublateral carinae sculptured as basal two-thirds of disk but with the punctures slightly finer and sparser. Lateral margins nearly smooth. *Elytra* slightly more than twice as long as pronotum (1.50 mm. : 0.70 mm.) and at broadest point, which is across apical two-fifths, broader than broadest point across humeri (1.07 mm. : 0.97 mm.). Lateral margins nearly smooth. Apices feebly and broadly produced and conjointly rounded. Surface with the striae feebly impressed on sides and apex but not impressed on disk; discal striae punctures round to subquadrate, about a third to a half as broad as

intervals, and separated longitudinally by once or, more rarely, twice their diameters; these punctures become finer towards apex and coarser, denser and deeper towards sides. Intervals flat and with the surface moderately densely to sparsely alutaceous, and with a few obscure granules at base and sides which are similar in size to those of sides of pronotum. *Scutellum* flat, subparallel, longer than broad (0.10 mm. : 0.075 mm.), base very feebly rounded, and apex broadly rounded; surface sculptured as adjacent parts of elytra. *Prosternum* with the carinae short and present only on basal third (text-fig. 91); when viewed laterally the anterior three-fourths (not including process) is gradually but moderately strongly bent ventrally; process shaped as figured (text-fig. 91); surface of base of prosternum and all of that of process sculptured like that of head except that surface of process is also feebly rugose; surface of prosternum elsewhere, and also that of hypomera, with the granules similar in size to those of sides of pronotum but feebly oblong and with the surface between granules alutaceous like that of head. *Mesosternum* with the groove for the reception of the prosternal process broad and long, posterior two-fifths deeper and about a third broader, and extending to posterior eighth of mesosternum; surface on each side of groove sculptured as head but with the granules not distinct. *Metasternum* with the median longitudinal impression extending to anterior sixth, basally as broad as scutellum and half as deep as broad, and apically shallower and a third to a fourth as broad; disk feebly depressed posteriorly and on each side in front of posterior coxae with a deep, nearly oval impression which is about 0.05 mm. broad; carina on each side of disk extending posteriorly and slightly outwards half way to hind coxa; surface of disk with round and shallow punctures which are about 0.02 mm. broad and are usually separated by twice their diameters; surface between punctures for the most part only very sparsely microscopically alutaceous; surface of sides of metasternum sculptured somewhat similarly to basal portion of pronotal disk but with the granules distinctly oblong instead of round. *Abdomen* with the carina on each side of the middle of the first sternite extending posteriorly and outwards to posterior fourth of segment; surface of sternites at sides sculptured as sides of metasternum but with the granules slightly finer and sparser; middle region of basal four sternites, and to a slight extent that of fifth sternite, with the granules sparser than at sides, rounded, and the surface between the granules often smooth and polished. *Genitalia* as figured (text-figs. 84, 85).

Female: Externally similar to male.

Type: In the U.S. National Museum. MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. 6000-7000 ft., v-vii.1933 (*H. E. Hinton, R. L. Usinger*).

Specimens examined: 154, with same data as type; 1, collected in the same district at Tejupilco, alt. about 4000 ft., ii-vi.1933 (*H. E. Hinton, R. L. Usinger*); 433, Real de Arriba, v-vii.1934 (*H. E. Hinton*); 362, in the same district, but at Rio Verde, alt. about 8000 ft., 14.vi.1934 (*H. E. Hinton*).

Variations: In this long series there appears to be very little variation, the most notable variation being in the length of the metasternal discal carinae which in some specimens are confined to anterior fourth, while in some they extend three-fifths of the way to hind coxae.

LARVAE.

The larvae of this genus were determined by elimination and according to locality. A brief generic diagnosis follows.

Generic Characters of Larvae of Tolriolus.

Body subparallel and cylindrical to subtriangular in cross section; dorsal surface with numerous gibbosities. *Head* when seen from above exposed and not concealed by pronotum; anterior margin toothed on each side between base of antenna and clypeus. Clypeal suture distinct. With one ocellus on each side. Antennae 3-segmented (text-fig. 95) and feebly retractile. Mandibles of both sides similar and with three obtuse apical teeth; prostheca long, slender, and densely spinose. Maxilla (text-fig. 102) with the palp 4-segmented and stipes showing no differentiation into a palpifer; galea and lacinia separate and apex of each densely spinose. Labium (text-fig. 101) with the postmentum undivided; labial palp 2-segmented and prementum without a distinct palpiger. Gula well-developed. *Prothoracic pleura* divided into two parts and anterior part meeting on middle line of body so that the sternum is here completely suppressed. Meso- and metapleura divided into two parts. Abdominal segments one to seven with the pleura bounded by tergo- and sternopleural sutures and these two sutures converge and meet at apex of seventh segment; segment eight forming a complete sclerotized ring. Operculum with two strongly sclerotized claws attached to its dorsal membrane. Apex of ninth segment deeply and acutely emarginate. *Spiracles* present on mesothorax and first eight abdominal segments and opening on the apices of small tubercles. Tracheae without air sacs. *Alimentary canal* with an oesophageal sclerite on the dorsal posterior margin of the oesophagus. Hind gut with six? (my material is not sufficiently well preserved to be sure of this number) Malpighian tubules. *Central nervous system* with three thoracic and eight abdominal discrete ganglia.

The larvae of this genus are close to *Elsianus*, but may at once be distinguished by the gibbosities on the dorsal surface. All species of *Elsianus* (about 15 have been examined) have the dorsal surface evenly convex.

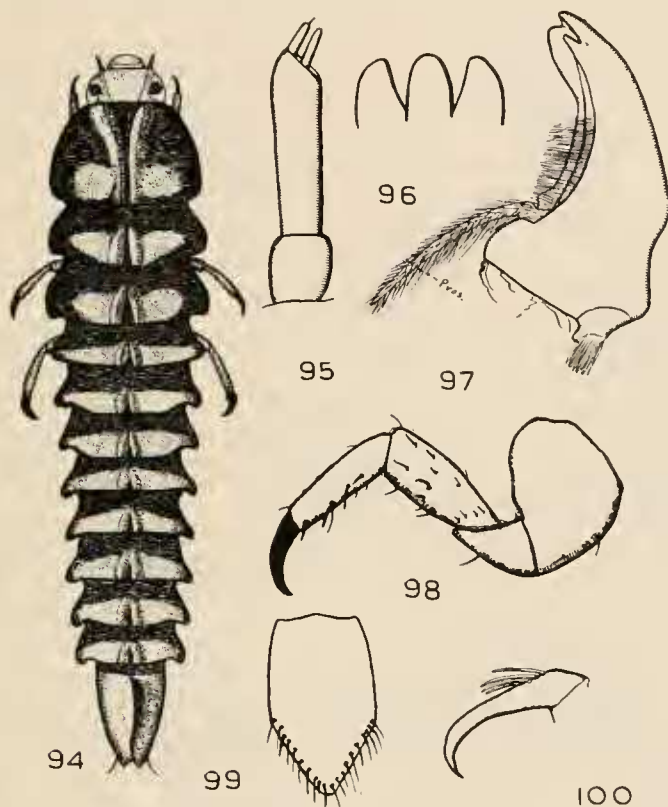
Description of Mature Larva of T. ungulatus.

(Text-figs. 94-104.)

1936. *Macronychooides ungulatus* (Hinton), *Trans. R. Ent. Soc. Lond.*, 85 (18): 420, figs. 30-40.

Length 4 mm. (text-fig. 94). Body subtriangular to nearly cylindrical in cross section. Pro-, meso-, and metanotum subequal in breadth; abdominal segments feebly narrowed caudally. More heavily sclerotized parts of body fusco-testaceous; antennae, mouth-parts, legs, opercular claws, and inter-segmental membranes pale testaceous. Dorsal and ventral sclerotized areas mostly tuberculate, each tubercle (except fine tubercles at anterior margin of segments) with a short seta near apex on posterior side (text-fig. 103 *a*); also with a few sparsely scattered, extremely fine setae arising independently of tubercles. *Head capsule* abruptly rounded and truncate behind, not constricted to form a neck. Anterior four-fifths of dorsal surface and sides slightly coarsely tuberculate, with the tubercles separated mostly by about one to three times their diameters; surface also with sparse minute pale areas from which arise setae, on basal one-fifth with three similar but much larger areas on each side and from each arises a single seta. Ventral surface with only the area between the ventral sutures tuberculate; elsewhere not tuberculate. Frontal sutures well-developed and extending on each side from near the base of the antenna to unite at middle just before posterior

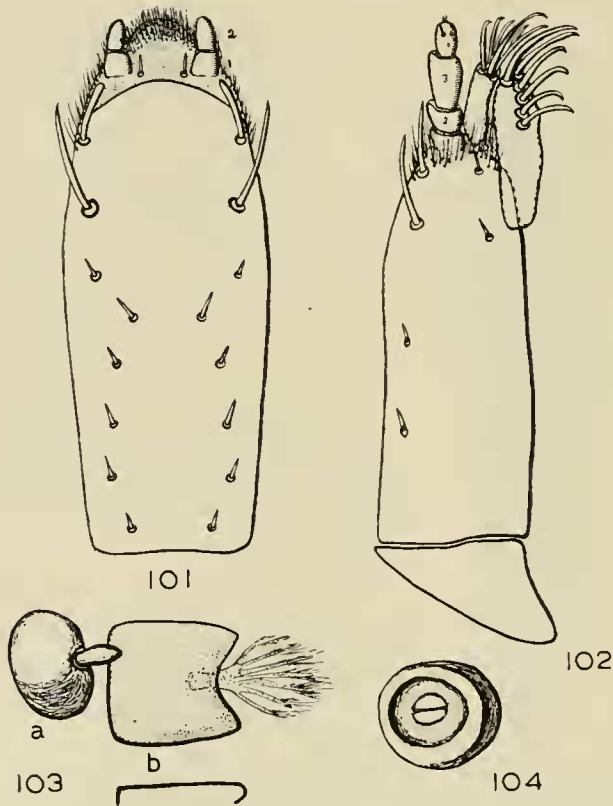
margin. Single ocellus on each side in a large pigment spot. Labrum transverse; anterior margin feebly rounded, and anterior angles broadly rounded. Antennae as figured (text-fig. 95). Mandibles as figured (text-fig. 97), and maxilla and labium as figured (text-figs. 101, 102). *Pronotum* about a third broader than long; narrowed anteriorly; angles rounded; with two prominent longitudinal ridges parallel near base and from apical half diverging moderately towards apex; near base on



TEXT-FIGS. 94-100.—Larva of *Tolriolus unguatus* Hinton. (94) Mature larva. (95) Antenna. (96) Inner view of tip of mandible. (97) Mandible. (98) Left inner view of middle leg. (99) Ventral view of operculum. (100) Dorsal view of opercular claw.

each side with a rounded and elevated area. Surface slightly coarsely tuberculate with tubercles which are mostly separated by once to twice their diameters; anteriorly with the tubercles slightly finer and denser; anterior and posterior margins with a row of flat quadrate tubercles (text-fig. 103b) from each of which arises a multi-branched seta. Mesonotum more than twice as broad as long (0.875 mm.; 0.375 mm.); similar to pronotum but with the longitudinal ridges joining in front and not attaining apex; with the hind angles feebly produced; anterior belt of very fine tubercles with the tubercles separated mostly by less than their diameters. Metanotum generally similar to mesonotum. *Dorsal abdominal segments* similar to metanotum but more strongly transverse and gradually narrowing caudally; caudal segments with the hind angles increasingly strongly

produced posteriorly. Eighth abdominal segment with the channel between the dorsal ridges very feeble. Ninth dorsal three-fifths as broad as long (0.375 mm. 0.625 mm.), triangular, subconical, with a single median longitudinal ridge, and with the caudal end deeply and triangularly emarginate. *Pleural areas* mostly finely tuberculate as anterior margins of dorsal segments; posterior margins of these also with a row of flat and subquadrate tubercles. *Ventral surface* tuberculate as dorsal; with the anterior margin of the prosternum and posterior



TEXT-FIGS. 101-104.—Larva of *Tolriolus unguatus* Hinton. (101) Ventral view of labium. (102) Ventral view of right maxilla. (103a) Dorsal tubercle. (103b) Tubercle of posterior marginal row of mesothorax. (104) Mesothoracic spiracle.

margin of all other sterna except the ninth with a row of flat and subquadrate tubercles; metasternum with two small median longitudinal and carina-like tubercles at anterior margin; first abdominal sternite with a single similar tubercle at anterior margin. Operculum as figured (text-fig. 99); opercular claws (text-fig. 100) very slender and strongly curved. *Legs* all similar to that of mesothorax (text-fig. 98) but increasing in length posteriorly. *Spiracles* all similar to that of mesothorax (text-fig. 104).

Specimens examined: 20, MEXICO: Dist. de Temascaltepec, Real de Arriba and Río Verde, alt. 6000-8000 ft., vi-vii. 1934 (*H. E. Hinton*).

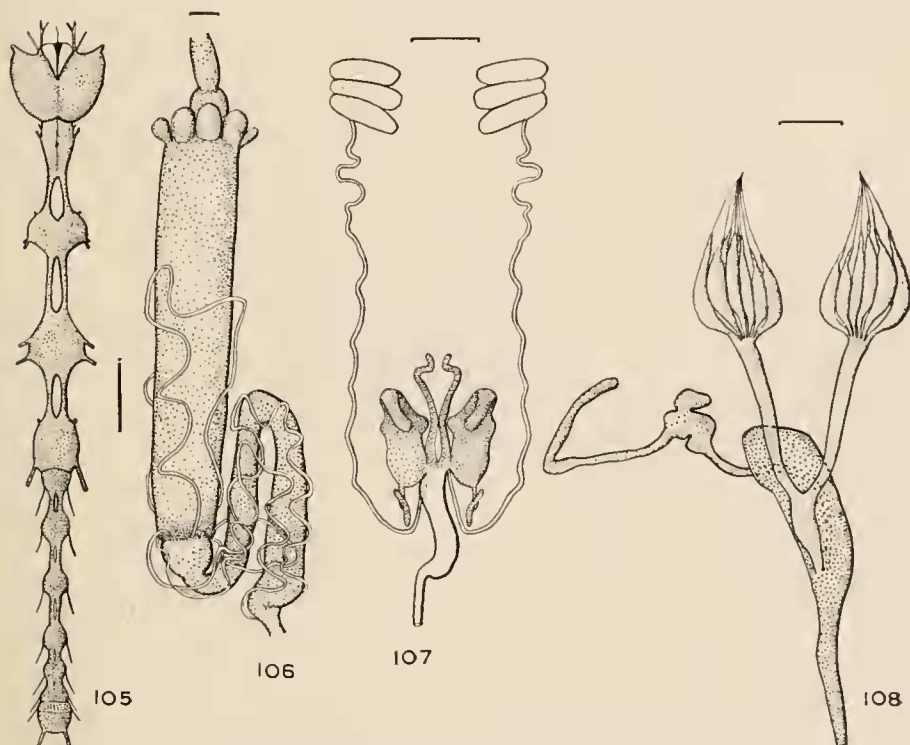
The largest available larva is 5.0 mm. and the smallest 2.0 mm. long, but

these seem to differ only in size. All specimens were taken in company with the adults clinging to roots of *Salix* and *Alnus* in cold and torrential mountain streams.

ELSIANUS Sharp.

1882. *Elsianus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 131.

At the time of writing 18 species have been described, and the genus is now known to occur from Texas to South Brazil. This genus will probably take

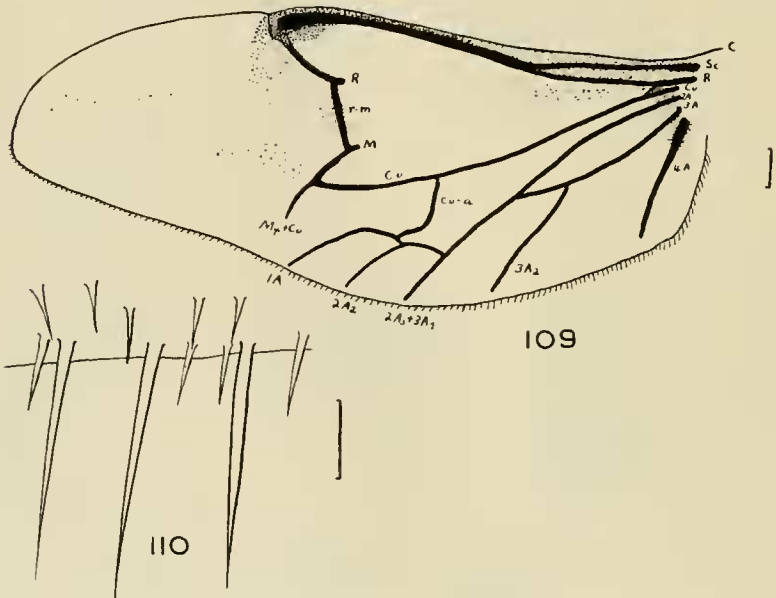


TEXT-FIGS. 105-108.—*Elsianus bicolor* Hinton. (105) Central nervous system from a dorsal view. (106) Alimentary canal. (107) Male reproductive system. (108) Female reproductive system.

second place to *Cylloepus* Erichson in number of species. Though to-day only 18 species have been described there are over 20 new species in my collection from South America. A redescription of the genus follows.

Body elongate, subparallel. Dorsal surface clothed with short, sparse or dense, usually recumbent hairs. Tomentum confined to the following areas: (1) genae; (2) epipleurae; (3) hypomera; (4) sides of prosternum, mesosternum, and abdominal sternites, but in many species nearly the entire ventral surface is clothed with scale-like or hairy tomentum; and (4) all of legs except tarsi, though in many species the scale-like tomentum is sparse or absent on the tibiae. Head when seen from below capable of being retracted so that none of the mouth-parts are visible. Antennae 11-segmented. Mandibles with three apical acute teeth; prostheca large and entirely membranous with the apex spinose or hairy. Maxilla

with the palp 4-segmented and stipes with a well-developed palpifer; galea and lacinia separate and apex of each densely spinose. Labium with the palp 3-segmented and prementum with a well-developed palpiger. Mentum transverse and about as broad as and about half again as long as submentum. Gula as long as mentum, anteriorly more narrow or as broad as submentum, and always narrowed posteriorly. *Pronotum* with the anterior margin moderately arcuate at middle and on each side behind eye before apical angle deeply sinuate. Base trisinate, broadly and moderately deeply so on each side and more narrowly and shallowly so in front of scutellum. With or without a sublateral carina; if a carina is present it may be complete or evident only near base; in front of scutellum sometimes with a gibbosity; disk with or without a median longitudinal



TEXT-FIGS. 109, 110.—*Elsianus striatus* Sharp. (109) Hind wing. Venation after Forbes. (110) Microtrichia from inner apical margin.

impression. *Elytra* striate and punctate; with an accessory stria on each elytron on basal sixth or fifth between sutural and second striae; without sublateral carinae. Hind wings without a radial cross vein and without an anal cell; with the first branch of the second anal absent; and with a cubito-anal cross vein. *Prosternum* very long in front of anterior coxae; prosternal process long and posterior margin broadly rounded or acute. Mesosternum with a broad and deep groove for the reception of the prosternal process. Metasternum with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae globular and trochantin completely concealed by the hypomera. Claws without teeth. *Alimentary canal* (text-fig. 106) with seven caeca on the anterior margin of the mid-gut. Hind gut with six Malpighian tubules which end near the rectum freely or embedded in the fatty tissue. *Male reproductive system* (text-fig. 107) with the lateral accessory glands with several lobes. Each testis with three sperm tubes. *Female reproductive system* (text-fig. 108) with eight egg tubes to each ovary. Spermathecal duct opening near base of bursa

copulatrix. *Central nervous system* (text-fig. 105) with three thoracic discrete ganglia. First abdominal ganglion partly fused to third thoracic, two to four free, and five to eight partly fused together though the limits of each are distinguishable.

GENOTYPE: *Elsianus striatus* Sharp.

The internal anatomy of four species has been examined and found to agree in essential details. *E. bicolor* Hinton of Bolivia is figured.

Elsianus may be immediately distinguished from the other genera in the tribe Elmini (except *Stenelmis* Dufour) by the accessory stria on each elytron at basal fifth or sixth between sutural and second stria. With the exception of *Stenelmis* Dufour, it is the only genus known to me which has three sperm tubes to each testis. From *Stenelmis* it may be distinguished by the densely pubescent apices of the tibiae and the presence of caeca on the anterior margin of the mid-gut.

The specific characters of most importance in separating the species of *Elsianus* seem to be the following:

- (1) General proportions, length and breadth.
- (2) Size and distribution of the punctures and tubercles on the various sclerites.
- (3) Condition of fronto-clypeal suture.
- (4) Anterior margin of clypeus, whether rounded, truncate, emarginate, or sinuate; and also shape of angle on each side.
- (5) Condition of anterior margin of labrum.
- (6) Outline of pronotum and extent and depth of the impression or gibbosity on its surface. Shape and extent of sublateral carinae if present.
- (7) Shape of elytral apices.
- (8) Condition of lateral margin of elytra, whether crenate or smooth.
- (9) Shape of scutellum and if convex or flat.
- (10) Shape of prosternal process.
- (11) Shape of mesosternal groove and depth.
- (12) Impressions on disk of metasternum.
- (13) Condition of carinae of first abdominal sternite.
- (14) Extent and depth of impression on middle of first abdominal sternite.
- (15) Extent and depth of depressions on other sternites. A depression is frequently present on apex of fifth sternite.
- (16) Secondary sexual characters.
- (17) Structure of male genitalia.
- (18) Relative size of the dorsal and ventral caeca on the anterior margin of the mid-gut. In some species the ventral caeca are very much smaller than dorsal, while in other species all caeca are the same size.
- (19) Shape of median and lateral accessory glands of male reproductive system.

The following secondary sexual characters have been observed by examining the 30 or so species in my collection:

- (1) Male with the anterior portion of the labrum very densely clothed with fine, long, erect, pale hairs, while in the female the hairs are at most two-thirds as long and are confined to sides (*clypeatus*, *tarsalis*).
- (2) Metasternum of males on each side of disk with an area clothed with long, fine, testaceous, recumbent hairs (*clypeatus*, *tarsalis*).

- (3) Metasternal disk on each side with a large and deep depression in males and with a broad, scarcely noticeable depression in females (*clypeatus*).
- (4) Metasternum with the median longitudinal line much more broadly impressed in male than in female (*clypeatus*).
- (5) Middle of first abdominal sternite more depressed in male than in female (*scutellaris*).
- (6) Apical margin of fifth abdominal sternite differently formed in male than in female (sp. n., BOLIVIA).
- (7) Male with the shape of the depression on the apical abdominal sternite different to that of the female (*aequalis*, *clypeatus*).
- (8) Apical abdominal sternite of male with a broad, basal, non-granulate and nearly impunctate area, while in the female this area is granulate (*clypeatus*, *scutellaris*).
- (9) Apical third of fifth abdominal sternite of male with an area on each side which is densely clothed with very long, fine, golden hairs, while in the female the same area is only clothed with very much shorter and sparser hairs (*clypeatus*, *tarsalis*).
- (10) Male with the apex of the hind tibiae broadened and on inner side concave (sp. n., BRAZIL).
- (11) Hind tibiae of male with the inner apical spur long and flexed inwards, whereas in the female the corresponding spur is short and straight (*tarsalis*).
- (12) Hind tibia of male with the inner apical spur relatively broader than corresponding spur of female (*clypeatus*).
- (13) Males with long and fine hairs on ventral side of four basal segments of all tarsi, whereas in the female there are only short and stout hairs or spines (*aequalis*).
- (14) Males with long and fine hairs on ventral apices of four basal segments of hind tarsi (*sandersoni*, *striatoides*).

A KEY TO THE MEXICAN SPECIES OF *Elsianus*.

1. Pronotum with a prominent gibbosity near base in front of scutellum 2.
 Pronotum without a gibbosity 3.
2. Species over 4.0 mm. long. Prosternal process with the apex acute; mesosternum with the posterior part of the groove for the reception of the prosternal process narrowed to an acute point. MEXICO.
E. scutellaris Hinton (1934).
 Species 4.0 mm. long or less. Prosternal process with the apex broadly rounded; mesosternum with the posterior part of the groove for the reception of the prosternal process very broadly and feebly rounded.
 COSTA RICA, MEXICO *E. graniger* Sharp (1882).
3. Species usually about 6.0 mm. and never less than 5.5 mm. long. MEXICO
E. grandis Hinton (1934).
 Species never more than 5.0 mm. long 4.
4. Male with no long and fine hairs on ventral apex of first four segments of hind tarsi. GUATEMALA, MEXICO. *E. striatus* Sharp (1882).
 Males with numerous long (about equal to lengths of their respective segments) and fine hairs on ventral apex of first four segments of hind tarsi 5.

5. Male genitalia with the median lobe extending much beyond apices of lateral lobes. MEXICO *E. striatoides* Hinton (1936).
 Male genitalia with the median lobe not extending to apices of lateral lobes. MEXICO *E. sandersoni* Hinton (1936).

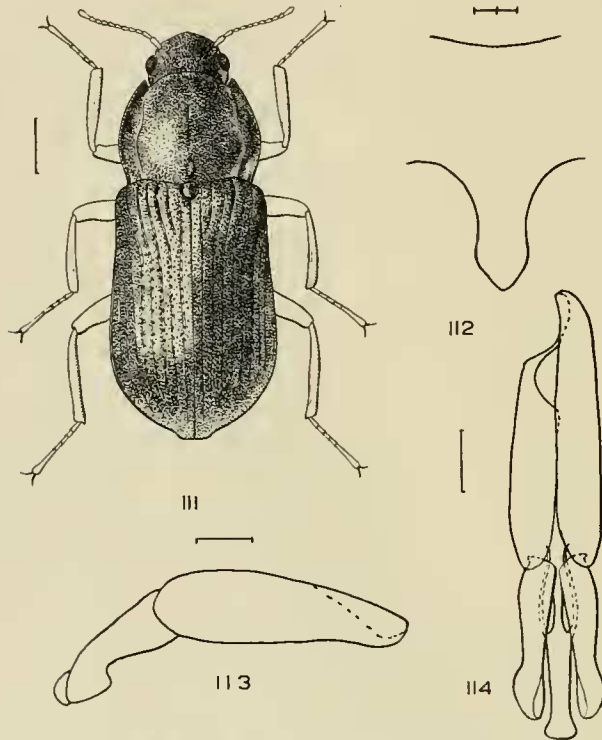
***Elsianus scutellaris* Hinton.**

(Text-figs. 111-114.)

1934. *Elsianus scutellaris* Hinton, *Rev. Ent., Rio de J.*, 4 (2) : 106.

Male : Length, 4.6 mm. ; breadth, 1.9 mm. Cuticle shining and black, with the antennae, mouth-parts, and tarsi rufo-piceous. *Head* without distinct impressions ; surface with feebly oblong granules which are about a third coarser than facets of eyes or 0.025 mm. broad and are separated usually by slightly less than to once their diameters ; surface between the granules microscopically alutaceous. Clypeus with the fronto-clypeal suture moderately deep and feebly and arcuately emarginate for its entire breadth ; anterior margin feebly and arcuately emarginate for its entire breadth, with the angle on each side very broadly rounded ; surface sculptured as head but with the granules slightly flatter and sparser. Labrum with the anterior margin feebly rounded and with the angle on each side broadly rounded ; surface with the basal and lateral parts extremely densely and very finely alutaceous, middle apical region not alutaceous and with punctures which are about a third as coarse as granules of head and are separated by one to five times their diameters ; sides with a few long (0.075 mm.), fine, testaceous hairs. *Pronotum* across broadest point, which is about at basal third, broader than long (1.62 mm. : 1.50 mm.) and base broader than apex (1.40 mm. : 0.97 mm.). Sides arcuate, moderately strongly and shortly sinuate before basal angles and very feebly and broadly sinuate at apical two-fifths. Lateral margins feebly and somewhat regularly crenate. Sublateral carina prominent, extending from near base to apical seventh, and feebly sinuate and for short distance much less prominent at about basal two-fifths ; on basal seventh in front of scutellum with a longitudinal gibbosity which is 0.10 mm. broad, 0.22 mm. long, and about 0.07 mm. high ; disk with a very shallow moderately broad median longitudinal impression which extends from apical two-fifths to near anterior part of gibbosity. Surface of pronotum sculptured similarly to that of head but with the granules round, not oblong, very slightly coarser, and usually separated by once to twice their diameters ; extreme base and inner sides of sublateral carinae on basal fourth with the alutaceous microsculpture much less dense than elsewhere. *Elytra* more than twice as long as pronotum (3.4 mm. : 1.50 mm.) and broadest point, which is at apical third, slightly broader than broadest point across humeri (1.9 mm. : 1.8 mm.). Lateral margins finely and regularly crenate. Apices moderately produced and each apex obliquely truncate so that the more anterior part of the truncation is mesal. Surface with the striae coarse and becoming finer towards apex and slightly coarser towards sides ; discal striae punctures usually round, about a half to a third as coarse as intervals, and separated longitudinally by one to a little more than one diameter. Intervals more or less flat but with the third (or fourth if accessory interval is included) feebly convex from basal fifth to eighth ; surface of intervals sculptured as pronotum but intervals at middle apical three-fourths with the granules much sparser. *Scutellum* subovate, strongly convex, particularly posteriorly, longer than broad (0.25 mm. : 0.22 mm.), base broadly and feebly rounded, and much narrowed to the feebly rounded apex ; surface sculptured as the adjacent elytral intervals

but with the granules slightly denser. *Prosternum* with the process (text-fig. 112) acute at apex and the margin opposite front coxae raised so that middle part of process and basal part of prosternum appear moderately depressed; surface of process coarsely and densely rugose and anteriorly transversely and more sparsely so; anterior portion of prosternum granulate somewhat similarly to clypeus and sides as well as hypomera granulate as pronotal disk. *Mesosternum* with the groove for the reception of the prosternal process deep and broad and posteriorly narrowed to an acute point; surface at sides sculptured as middle apical region



TEXT-FIGS. 111-114.—*Elsianus scutellaris* Hinton. (111) Adult to show general appearance. (112) Prosternum. (113) Lateral view of male genitalia. (114) Dorsal view of male genitalia.

of prosternal process. *Metasternum* with the median longitudinal impressed line extending to anterior eighth; disk with the posterior four-fifths deeply depressed; surface of disk with the granules about a third coarser than those of pronotum, oblong and separated mostly by a third to once their length; sides of metasternum granulate as disk of pronotum. *Abdomen* with the first sternite feebly depressed at middle and anterior and basal lateral margins moderately strongly raised; carinae of first sternite straight and complete; surface of middle of first sternite densely rugose and granulate, surface of other sternites granulate somewhat similarly to pronotum; basal middle of fifth abdominal sternite without granules or punctures but only microscopically alutaceous; apex of fifth sternite with a large, transversely oval, moderately deep depression. *Genitalia* as figured (text-figs. 113, 114).

Female : Externally similar to male except as follows : (1) the middle of the first abdominal sternite is only very feebly depressed ; (2) there is no middle basal impunctate and non-granulate area on the fifth abdominal sternite ; and (3) the apical depression of the fifth sternite is much shallower.

Type : ♀ in the British Museum (Nat. Hist.). MEXICO : Dist. de Temascaltepec, Temascaltepec, alt. about 5600 ft., 28.v.1933 (*H. E. Hinton, R. L. Usinger*).

Specimens examined : 13, with same data as above but collected in 1934 (*H. E. Hinton*).

Variations : In some males the basal impunctate area of the fifth abdominal sternite is confined to the extreme basal middle part, while in other specimens it extends on middle as far as apical two-thirds.

Comparative notes : This species belongs to a small group which is characterized by having a prominent gibbosity on the pronotum in front of the scutellum. The only other representative of this group in North America is the Guatemalan and Mexican *E. graniger* Sharp. From *graniger* it may be distinguished as follows : (1) *scutellaris* is larger (4.6 mm. : 4.0 mm.—largest specimen of *graniger* I have seen) ; (2) apices of elytra obliquely truncate with the most anterior part of the truncation lateral, whereas in *graniger* the most anterior part of the truncation is mesal ; (3) prosternal process with the apex acute instead of broadly rounded ; and (4) mesosternum with the anterior part of the groove for the reception of the prosternal process narrowed to an acute point instead of broadly rounded. The male genitalia of the two species are also quite different (*cf. figures*).

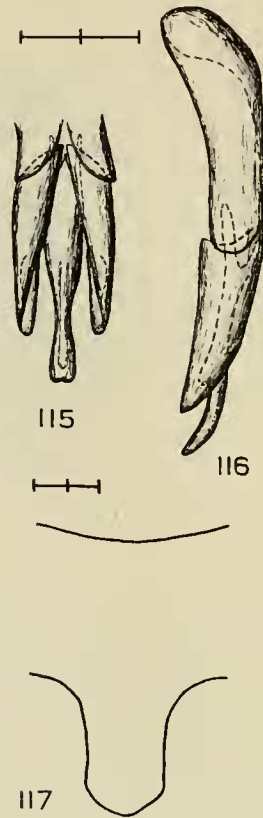
Elsianus graniger Sharp.

(Text-figs. 115-117.)

1882. *Elsianus graniger* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 133.

Male : Length, 3.4 mm.—4.0 mm. ; breadth, 1.3 mm.—1.8 mm. Cuticle shining and rufo-piceous to black ; antennae, mouth-parts and legs paler rufo-piceous. *Head* without distinct impressions ; surface with round to feebly oblong granules which are about 0.024 mm. broad or about a third coarser than facets of eyes and are usually separated by once their diameters or a little more ; surface between granules microscopically alutaceous. Clypeus with the fronto-clypeal suture moderately deep and so shaped that the anterior margin of the head is feebly and arcuately emarginate for its entire breadth between antennae ; anterior margin very feebly emarginate or nearly truncate for its entire breadth ; and with the angle on each side very broadly rounded ; surface sculptured as head but with the granules slightly flatter. Labrum with the anterior margin broadly rounded and the angle on each side broadly rounded ; surface at sides and on basal middle sculptured as clypeus but more finely so ; surface on a middle apical belt with punctures only, which are about two-thirds as coarse as granules and are separated by one to four times their diameters ; each side with a few fine, long (about 0.05 mm.), recumbent, testaceous hairs. *Pronotum* at broadest point, which is at basal third, broader than long (1.35 mm. : 1.22 mm.) and base broader than apex (1.20 mm. : 0.80 mm.). Sides arcuate, less strongly so at basal and apical third but nowhere sinuate. Lateral margins feebly and regularly crenate. Sublateral carinae prominent, extending from very near base to apical ninth, and feebly sinuate and for a short distance much less prominent at basal two-fifths ; on basal seventh in front of scutellum with a gibbosity which is 0.12 mm. long,

0.07 mm. broad, and about 0.04 mm. high; disk with a narrow, very shallow, and indistinct median longitudinal impression extending from basal fourth to apical fourth. Surface of pronotum sculptured similarly to that of head but with the granules always round, often slightly coarser, and separated mostly by once to twice their diameters; surface along extreme base with the alutaceous microsculpture much less dense. *Elytra* more than twice as long as pronotum (2.45 mm. : 1.22 mm.) and broadest point, which is at apical third, slightly broader than



TEXT-FIGS 115-117.—*Elsianus graniger* Sharp. (115) Dorsal view of male genitalia. (116) Left lateral view of same. (117) Prosternum.

broadest point across humeri (1.40 mm. : 1.30 mm.). Lateral margins finely and regularly crenate. Apices moderately produced and each apex obliquely truncate so that the most anterior part of the truncation is mesal and not as usual lateral. Surface with the striae moderately coarse and becoming coarser towards sides and finer towards apex; discal strial punctures usually round, from a third to two-fifths as coarse as intervals, and separated longitudinally by once their diameters or a little more. Intervals all more or less flat but with the third (not including extra interval formed by accessory stria) more obviously convex from basal sixth to eighth; surface of intervals sculptured as pronotum but on discal part of apical half with the granules distinctly sparser. *Scutellum* sub-ovate, strongly convex, broader than long (0.21 mm. : 0.20 mm.), base broadly

and feebly rounded, and slightly narrowed towards apex which is broadly rounded; surface sculptured like adjacent intervals. *Prosternum* with the process (text-fig. 117) broadly rounded at apex and margin near base feebly raised so that area opposite this point appears feebly depressed; surface of process coarsely and densely rugose and also with the granules about a fourth coarser than those of elytra and separated by two to four times their diameters; anterior portion of prosternum, sides, and hypomera sculptured somewhat like pronotum. *Mesosternum* with the groove for the reception of the prosternal process deep and broad and with the posterior margin broadly rounded; surface at sides sculptured as middle apical region of prosternal process but more finely so. *Metasternum* with the median longitudinal impressed line broad and extending to about anterior fifth; surface of disk with the granules about a third to half again as coarse as those of elytra and separated mostly by once their lengths, though very occasionally they are contiguous; sides of metasternum granulate as base of elytra. Abdomen with the first sternite at middle only feebly and broadly depressed and anterior and lateral basal margins moderately strongly raised; carinae of first sternite straight and complete. Surface of first sternite at middle sculptured nearly as that of prosternal process, surface elsewhere and that of other sternites granulate as pronotum but with the granules slightly flatter and often feebly oblong. Apex of fifth sternite with a broad, transverse, and shallow impression. *Genitalia* as figured (text-figs. 115, 116).

Female: Externally similar to male.

Type: In the British Museum (Nat. Hist.). COSTA RICA: Cache (*H. Rogers*).

Specimens examined: 52, MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. about 5600 ft., vi-vii. 1933 (*H. E. Hinton, R. L. Usinger*); 23, same locality but vi-vii. 1934 (*H. E. Hinton*); 3, same data as above but at Tejupilco, alt. about 4000 ft., vii. 1934 (*H. E. Hinton*); and 4, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*).

Variations: In some the sides of the pronotum are distinctly sinuate before basal angles. The basal gibbosity of the pronotum varies from being distinctly longer than broad to being quite round, and as regards prominence, from 0.05 mm. to 0.015 mm. high.

Comparative notes: This species can be compared only with the larger *E. scutellaris* Hinton, as these two are the only North American species possessing a gibbosity in front of the scutellum on the pronotal base. The differences between these two are given under the description of *scutellaris*.

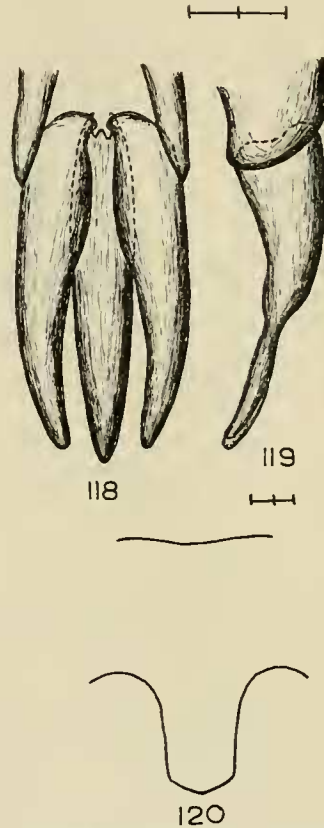
***Elsianus grandis* Hinton.**

(Text-figs. 118-120.)

1934. *Elsianus grandis* Hinton, *Rev. Ent., Rio de J.*, 4 (2) : 195.

Male: Length, 5.7 mm.-6.0 mm.; breadth, 2.3 mm.-2.6 mm. Cuticle shining and rufo-piceous to black; antennae, mouth-parts, and legs paler rufo-piceous. *Head* without distinct impressions; surface with round, high granules which are about 0.018 mm. broad or about as coarse as facets of eyes and are usually separated by two to three times their diameters; surface between the granules densely and microscopically alutaceous. Clypeus with the fronto-clypeal suture deep and formed so that the anterior margin of the head is very feebly and arcuately emarginate for its entire breadth between antennae; anterior

margin arcuately and very feebly emarginate for its entire breadth and with the angle on each side very broadly rounded; surface sculptured as that of head. Labrum with the anterior margin feebly rounded and with the angle on each side broadly rounded; surface without distinct granules but densely and microscopically alutaceous except for a narrow anterior belt which is broadest at middle and which is only sparsely alutaceous; sides with a few long (0.07 mm.), fine, recumbent testaceous hairs. *Pronotum* across broadest point, which is at basal



TEXT-FIGS. 118-120.—*Elsia grandis* Hinton. (118) Dorsal view of male genitalia. (119) Left lateral view of same. (120) Prosternum.

two-fifths, broader than long (2.05 mm. : 1.62 mm.) and base broader than apex (1.85 mm. : 1.17 mm.). Sides arcuate, nearly straight or scarcely noticeably sinuate at apical fourth, and feebly sinuate before basal angles. Lateral margins finely and regularly crenate. Sublateral carinae prominent, extending from base to apical fifth, and sinuate and for a short distance less prominent at basal two-fifths; disk without a distinct median impression; with a moderately shallow and broad depression beginning on inner side of sublateral carina at basal two-fifths and extending obliquely backwards for a distance equal to a little more than the length of the scutellum. Surface sculptured similarly to that of head but with

the granules on disk not so high and separated by three to four times their diameters, the surface between the granules much less densely alutaceous, and the granules at sides of pronotum about a third coarser and slightly denser; area near inner side of sublateral carina near basal fourth nearly free of granules. *Elytra* more than two and a half times as long as pronotum (4.4 mm. : 1.6 mm.) and broadest point, which is at apical third, broader than broadest point across humeri (2.45 mm. : 2.15 mm.). Lateral margins finely and regularly crenate. Apices broadly and moderately produced so that each apex is obliquely truncate and the most anterior part of the truncation is lateral. Surface with the striae coarse and becoming finer towards apex and slightly coarser towards sides; discal striae punctures usually round, deep, about a third as broad as intervals, and separated longitudinally by slightly more than their diameters. Intervals more or less flat; surface of intervals sculptured as sides of pronotum but with the granules slightly sparser and on middle apical three-fifths and lateral half much sparser and finer, here often being separated by as much as five times their diameters. *Scutellum* strongly convex, nearly round but slightly longer than broad (0.37 mm. : 0.32 mm.), and base and apex broadly rounded; surface sculptured as sutural interval. *Prosternum* with the process (text-fig. 120) broadly rounded at apex and the margin opposite middle coxae very thickly and feebly raised; surface of process sculptured as sides of elytra and also feebly rugose; surface of anterior portion of prosternum, sides and hypomera sculptured as sides of pronotum. *Mesosternum* with the groove for the reception of the prosternal process broad and deep but posteriorly much narrowed and much deeper than elsewhere; sides with the surface coarsely rugose. *Metasternum* with the median longitudinal impressed line extending to anterior sixth; disk with the posterior four-fifths feebly depressed; surface of disk with the granules oblong, about 0.05 mm. long, and usually separated by once their lengths though occasionally contiguous; sides of metasternum granulate as hypomera. *Abdomen* with the middle of the first sternite broadly and moderately deeply depressed on most of the middle area; first sternite without carinae; surface of sternites granulate as sides of metasternum but with the granules becoming finer and slightly sparser towards apex; middle apical portion of first sternite and middle basal portion of second sternite with the surface between the granules nearly free of the alutaceous microsculpture and highly polished. *Genitalia* as figured (text-figs. 118, 119).

Female: Externally similar to male.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. about 7000 ft., 13.vi.1933 (*H. E. Hinton, R. L. Usinger*).

Specimens examined: 3, with data as above; 5, with same data but taken vi-vii.1934 (*H. E. Hinton*); and 2, in the same district at Rio Verde, alt. 7000-8000 ft., 14.vi.1934.

Variations: The scutellum is in some specimens moderately narrowed in apical half, whereas in others it is nearly round. The apical sixth of the scutellum of one specimen is very abruptly flattened whereas in the remainder of the series the scutellum is fairly evenly convex.

Comparative notes: This is the largest species of North American Elmini. From its close allies *E. striatus*, *E. striatoides* and *E. sandersoni* it may at once be distinguished by its much larger size (the largest specimen of these three species which I have seen is 5.0 mm., while the smallest of *grandis* is 5.7 mm.) and the structure of the male genitalia (*cf.* figures).

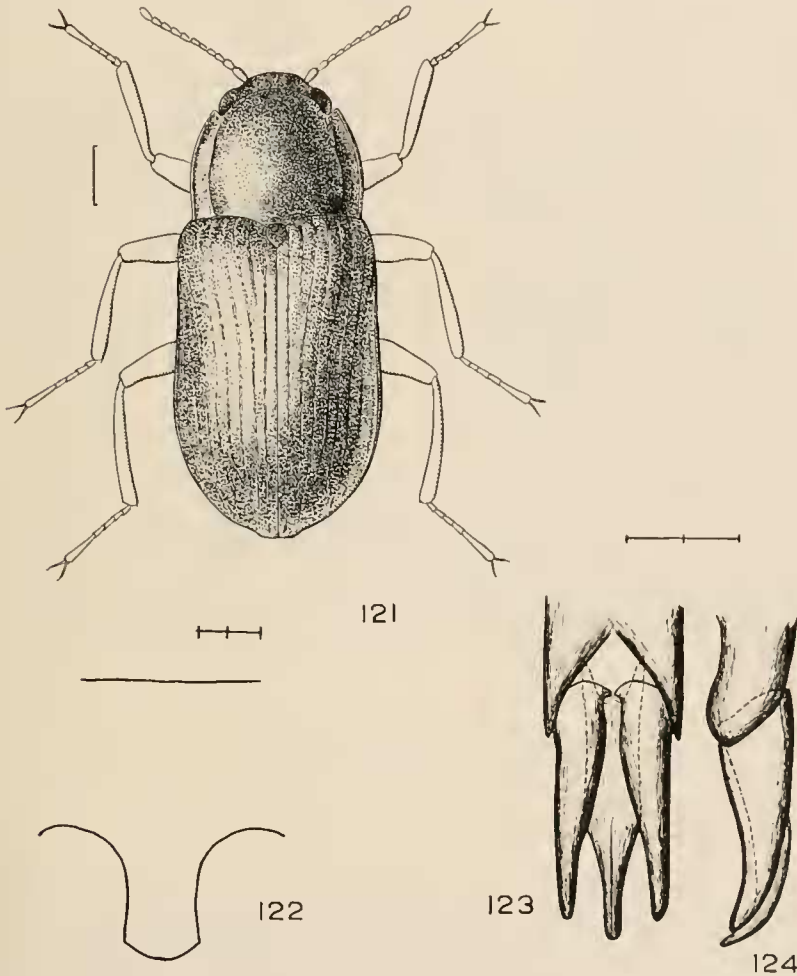
Elsianus striatus Sharp.

(Text-figs. 109, 110, 121-124.)

1882. *Elsianus striatus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 132.

Male : Length, 3.3 mm.-4.5 mm. ; breadth, 1.5 mm.-1.8 mm. Cuticle shining and rufo-piceous to black ; antennæ, mouth-parts and legs paler rufo-piceous. *Head* without distinct impressions ; surface with round high granules which are about 0.012 mm. broad or about as coarse as facets of eyes and are usually separated by once to twice their diameters or occasionally slightly more ; surface between the granules densely and microscopically alutaceous. Clypeus with the fronto-clypeal suture moderately deep and so shaped that the anterior margin of the head is arcuately and moderately feebly emarginate for its entire breadth between antennæ ; anterior margin of clypeus moderately strongly, arcuately emarginate for its entire breadth and with the angle on each side very broadly rounded ; surface sculptured as head. Labrum with the anterior margin feebly rounded and with the angle on each side broadly rounded ; surface without distinct granules and rather densely and microscopically alutaceous except for a narrow anterior belt which is broader at middle and which is without the alutaceous microsculpture ; the surface of this belt is frequently with punctures which are about a fourth to two-thirds as coarse as granules of clypeus and are contiguous to separated by five times their diameters ; surface at middle of apex often impunctate ; at sides with a few fine, long (about 0.05 mm.) recumbent, testaceous hairs. *Pronotum* across broadest point, which is about at basal third, broader than long (1.30 mm. : 1.15 mm.) and base broader than apex (1.15 mm. : 0.82 mm.). Sides arcuate, broadly and distinctly sinuate before basal angles, and very feebly scarcely noticeably sinuate at apical two-fifths. Lateral margins feebly and regularly crenate. Sublateral carina prominent, extending from very near base to apical seventh, and very feebly sinuate at about basal two-fifths ; disk without impressions. Surface granulate as head but with the granules on disk slightly finer, separated by two to three times their diameters, and with the surface between them set with fine punctures which are half as coarse as granules and are confluent to separated by once their diameters ; towards sides the granules become slightly larger and the punctures denser so that finally at sublateral carina the surface is again microscopically alutaceous as on head ; surface between sublateral carinae and lateral margins with the granules about a third coarser and slightly denser than those of head. *Elytra* nearly twice as long as pronotum (2.62 mm. : 1.15 mm.) and broadest point, which is at apical third, slightly broader than broadest point across humeri (1.55 mm. : 1.45 mm.). Lateral margins finely and regularly crenate. Apices moderately produced and each apex obliquely truncate so that the most anterior part of the truncation is lateral. Surface with the striae coarse and becoming slightly finer towards apex and slightly coarser towards sides ; discal strial punctures usually round to feebly subquadrate, two-thirds as coarse as intervals and separated longitudinally by once their lengths or a little more. Intervals flat but near base discal intervals are very feebly convex ; surface of intervals sculptured as sides of pronotum mesal to sublateral carina but with the granules sparser and the surface between the granules not punctate and only occasionally alutaceous ; discal region on apical half with the granules much finer and sparser. *Scutellum* subovate to nearly round, strongly convex, longer

than broad (0.22 mm. : 0.17 mm.), base broadly and feebly rounded, and apex narrowed and feebly rounded; surface sculptured as adjacent elytral intervals. *Prosternum* with the process (text-fig. 122) broadly rounded at apex and the lateral margins feebly and broadly raised so that the middle part of the process is moderately concave; surface of process sculptured as area of pronotum between



TEXT-FIGS. 121-124.—*Filsianus striatus* Sharp. (121) Adult to show general appearance. (122) Prosternum. (123) Dorsal view of male genitalia. (124) Left lateral view of same.

lateral margins and sublateral carinae but with the granules about a fourth coarser and slightly sparser; anterior area of prosternum granulate as basal discal part of elytra; sides and hypomera with the granules about as coarse as those of anterior part of prosternum but distinctly oblong and never round and usually separated by once their diameters. Mesosternum with the groove for the reception of the prosternal process deep and broad and narrowed posteriorly

where it is much deeper than elsewhere; surface at sides sculptured as prosternal process. Metasternum with the median longitudinal impressed line extending to anterior fourth or fifth; disk nearly flat, posteriorly only very feebly depressed, and surface with the granules about as coarse as those of prosternal process but flatter and usually confluent to separated by nearly once their diameters so that the whole surface has a subrugose appearance; sides of metasternum with the granules similar to those of sides of prosternum. Abdomen with the middle of the first sternite broadly and moderately strongly depressed; first sternite without carinae; surface of basal middle of first sternite sculptured as prosternal process; surface elsewhere and that of other sternites granulate as sides of metasternum but with the granules less oblong and more nearly round; surface of apical middle of first, all of middle of second, and basal middle of third sternite highly polished between granules. *Genitalia* as figured (text-figs. 123, 124.)

Female: Externally similar to male.

Type: In the British Museum (Nat. Hist.). GUATEMALA: Rio Naranjo, alt. 450 ft. (*Champion*).

Specimens examined: 3, MEXICO: Dist. de Temascaltepec, Tejupilco, alt. 4000 ft., vii. 1932 (*H. E. Hinton*); 205, with same data as above but collected in vi. 1933 (*H. E. Hinton, R. L. Usinger*); 11, as above but taken in vii. 1934 (*H. E. Hinton*); and 9, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*).

Variations: No variations worthy of mention have been noted.

Comparative notes: This is very closely related to *E. striatoides* Hinton and *E. sandersoni* Hinton. From both of these only the males can be positively distinguished by not having the ventral apical tufts of long and fine hairs on the four basal segments of the hind tarsi and by the structure of the male genitalia. The females of *striatus* are inseparable from those of *striatoides*, but from those of *sandersoni* they may be distinguished by their smaller size—being never more than 4.5 mm., whereas 5.0 mm. appears to be the normal size of females of *sandersoni*.

***Elsianus striatoides* Hinton.**

(Text-figs. 125–127.)

1936. *Elsianus striatoides* Hinton, *Trans. R. Ent. Soc. Lond.*, 85 (18): 422, figs. 15–17.

Male: Length, 4.5 mm.; breadth, 1.9 mm. Identical to *striatus* except as follows: (1) at ventral apex of each of the four basal segments of the hind tarsi with about two to four very fine, partly erect testaceous hairs which are about as long as their respective segments; and (2) male genitalia with the apex of the median lobe extending much further beyond apices of lateral lobes than is the case in *striatus* (*cf.* figures).

Female: Externally similar to male except that the ventral apices of the four basal segments of the hind tarsi have no long and fine hairs.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. 5600 ft., 28.v.1933 (*H. E. Hinton, R. L. Usinger*).

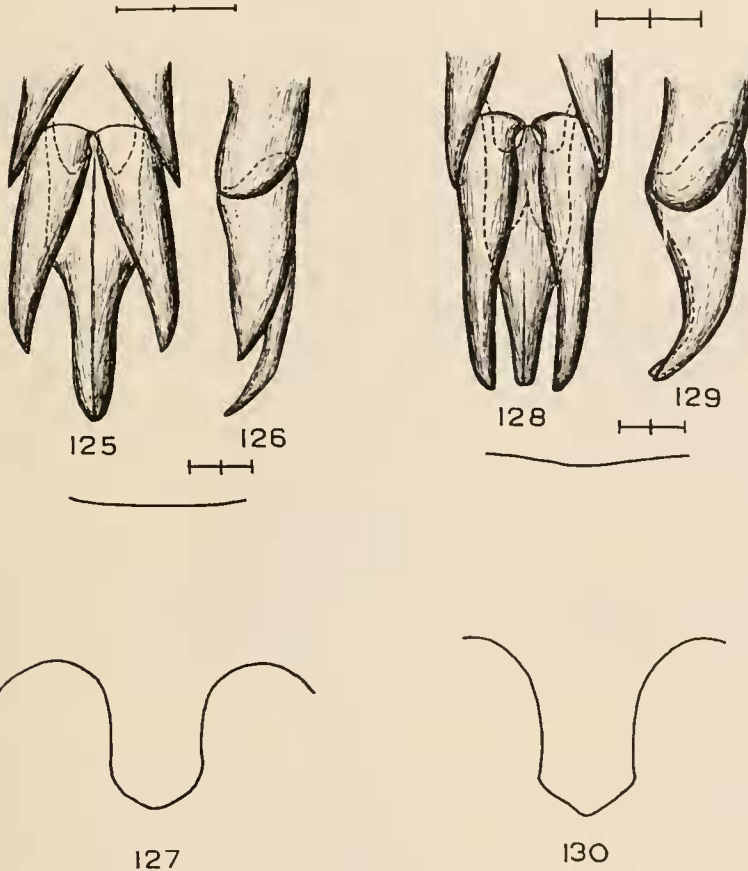
Specimens examined: 1, ♂ with data as above but collected on 5.vi.1933; and 4, ♀♀ which may belong to this species collected in the same district but at Real de Arriba, alt. about 7000 ft., 25.v.1933.

Elsianus sandersoni Hinton.

(Text-figs. 128-130.)

1936. *Elsianus sandersoni* Hinton, *Trans. R. Ent. Soc. Lond.*, 85 (18) : 420, figs. 12-14.

Male : Length, 4.5 mm.-5.0 mm. ; breadth, 1.87 mm.-2.05 mm. Identical to *striatoides* except that the genitalia have the apices of the lateral lobes extending



TEXT-FIGS. 125-130.—(125) Dorsal view of male genitalia of *Elsianus striatoides* Hinton. (126) Left lateral view of same. (127) Prosternum of same species. (128) Dorsal view of male genitalia of *E. sandersoni* Hinton. (129) Left lateral view of same. (130) Prosternum of same species.

slightly beyond the apex of the median lobe (*cf.* figures). First segment of front and middle tarsi with long and fine hairs on the ventral apex which are similar to those of first segment of hind tarsi. *E. striatoides* apparently has not fine long hairs on the ventral apex of the middle and front tarsi, but this may be due entirely to the fact that my two male specimens are badly rubbed.

Female : Externally similar to male but without the long and fine hairs on the tarsi.

Type : ♂ in the British Museum (Nat. Hist.). MEXICO : Dist. de Temascaltepec, Tejupilco, alt. 4000 ft., vii. 1934 (*H. E. Hinton*).

Specimens examined: 1, ♂, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*); and 4 ♀♀ with same data.

I have placed these females with this species because of their large size (5.0 mm.) though, apart from size, I have no good evidence that they belong to *sandersoni*, as *striatus* has also been taken in this locality.

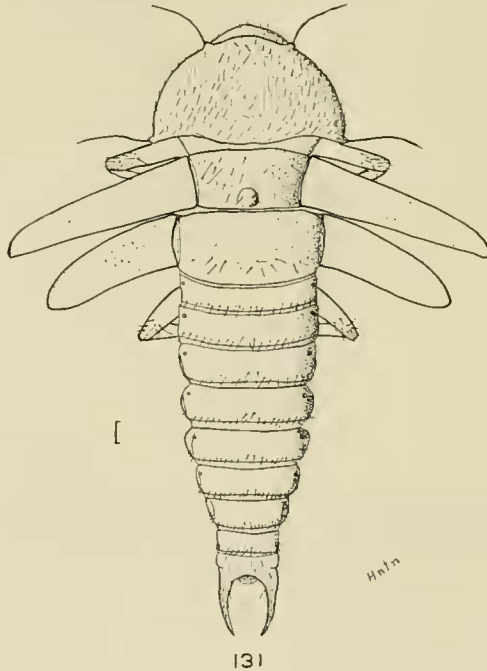
PUPAE.

About 18 specimens of the pupa of *Elsianus graniger* Sharp were taken by peeling off the moss matting which was growing above the water level on large stones in a small torrential stream. The pupal cells were formed in the earth held by the roots of the moss, and occasionally the ventral side of the cell was formed by the surface of the stone. A few of the pupae were allowed to emerge, and in this way the species was determined beyond doubt.

Description of Pupa of E. graniger Sharp.

(Text-fig. 131.)

Male: Length, 4.4 mm.-5.5 mm.; breadth (across metathorax and including front wings), 1.7 mm.-1.9 mm. *Head* concealed from above by pronotum so



TEXT-FIG. 131.—Pupa of *Elsianus graniger* Sharp.

that only the vertex is visible; without distinct impressions; surface densely microscopically alutaceous and with fine, erect pale hairs which are about 0.10 mm. long or more and arise at intervals from less than to one and a half their lengths. Antennae in normal position extending posteriorly and downwards to a point opposite anterior margin of front coxae. Clypeus with the

fronto-clypeal suture deep and straight; anterior margin nearly truncate and the angle on each side broadly rounded; surface as head but with a complete transverse row of setae at middle which are similar to the longer ones of head. Labrum with the anterior margin broadly, deeply, and arcuately emarginate and with the angle on each side broadly rounded; surface alutaceous as head but with only a few fine, short, recumbent setae. *Pronotum* similar in shape to that of the adult but with the sublateral carinae only feebly raised and the gibbosity in front of the scutellum not evident. Each apical and basal angle with a long (about 0.50 mm.), stout, curved seta; apical setae curved outwards and usually slightly shorter than basal; surface similar to that of head but with the hairs slightly denser. *Mesonotum* with a large and round gibbosity (text-fig. 131) which represents the scutellum beneath. Thoracic and abdominal segments as figured (text-fig. 131); ninth abdominal segment at apex with two lateral projections. *Wings* with the anterior pair extending to ventral side, attaining middle of third abdominal segment, and near apex separated from each other by a distance equal to more than their greatest breadth; posterior wings similarly extending to ventral side but much closer near apex and attaining apical margin of third abdominal segment. *Legs* with the front pair extending to posterior third of metathorax and tarsi separated from each other by about a third of their lengths; middle pair extending to posterior margin of metathorax and at apex seldom separated by more than the length of the fifth tarsal segment; hind pair with the coxa, trochanter, basal three-fourths of femur, apical half of tibia, and base of tarsus concealed by hind wings and the apical segments of the tarsi are contiguous along the middle line of the body and the claws extend to posterior margin of fifth abdominal sternite. *Abdominal spiracles* placed on dorso-lateral sides and opening on apices of small tubercles.

Female: Externally similar to male except that the middle apical margin of the eighth abdominal sternite (this is the sternite which corresponds to the sixth from base in the adults) is rounded and not moderately deeply emarginate as in male. The sexes may also be distinguished by the developing external genitalia.

LARVAE.

The larvae of this genus have been definitely determined as such, for the cast skin of a last instar larva was found with a pupa in a cell, and when the pupa emerged it proved to be that of *Elsianus graniger*.

The following brief generic diagnosis is the result of a study of the larvae of about 15 species in my collection.

Generic Characters of Larvae of Elsianus.

Body parallel, cylindrical. *Head* when viewed dorsally exposed and not concealed by the pronotum; anterior margin on each side between base of antenna and clypeus toothed. With one ocellus on each side. Antennae 3-segmented and feebly retractile. Mandibles of both sides similar and with three obtuse apical teeth; protheca long, slender, and densely spinose. Maxilla with the palp 4-segmented and the stipes showing no differentiation into a palpifer; galea and lacinia separate and apex of each densely spinose. Labium with the postmentum undivided; labial palp 2-segmented and prementum without or with only a very feebly developed palpifer. Gula well-developed. *Prothoracic pleura* (text-fig. 132) divided into two parts and anterior part meeting on middle

line of body so that the sternum is here completely suppressed. Meso- and meta-pleurae divided into two parts. Abdominal segments one to seven with the pleurae bounded by tergo- and sterno-pleural sutures; segments two to seven with a dorsal suture parallel to the suture usually considered to be the tergo-pleural, and if this dorsal suture is in fact the true tergo-pleural, then we must consider the pleurae to be longitudinally divided on segments two to seven; segment eight forming a complete sclerotized ring. Operculum with two strongly sclerotized claws attached to its dorsal membrane. Apex of ninth segment feebly to strongly emarginate. *Spiracles* present on mesothorax and first eight abdominal segments and usually opening on small tubercles. Tracheae without air sacs. Three tufts of retractile, anal, tracheal gills are present. *Alimentary canal* with an oesophageal sclerite on the posterior dorsal margin of the oesophagus. Hind gut with six Malpighian tubules which end freely near the rectum. *Central nervous system* with three thoracic and eight abdominal discrete ganglia.

This genus is close to no other known to me. The larvae of four Mexican species have been studied and of these it has only been possible with any certainty to give names to two. A table for the separation of these species follows:

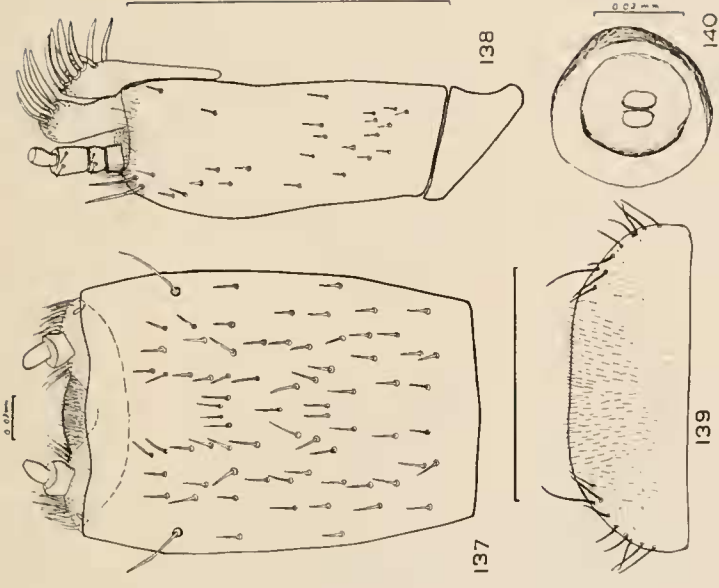
A KEY TO THE LARVAE OF THE MEXICAN SPECIES OF *Elsianus*.

1. Metasternum and first abdominal sternite anteriorly at middle with a longitudinal carina *E. graniger* Sharp.
Metasternum and first abdominal sternite without longitudinal carinae 2.
2. First abdominal sternite with the transverse and anterior reticulate belt extending to posterior fourth at middle of segment *E. striatus* Sharp.
First abdominal sternite with the transverse and anterior reticulate belt never extending at middle as far as posterior two-thirds of segment 3.
3. Setae which arise from posterior row of all segments except ninth round and densely and finely hairy; anterior middle portion of prosternum very strongly produced and anterior angles moderately strongly produced *E. sp. ?*.
Setae which arise from posterior row of tubercles of all segments except ninth flat and apically branched; anterior middle portion of basal prosternal sclerite only moderately produced and anterior angles not produced *E. (?) sp. ?*.

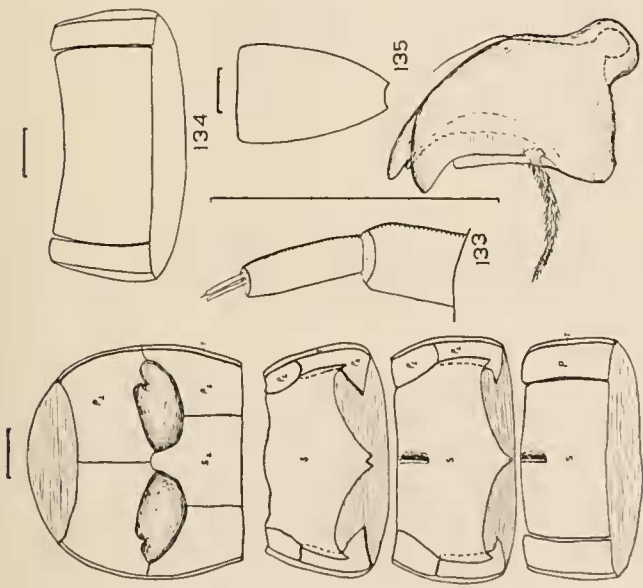
Description of mature larva of E. graniger.

(Text-figs. 132-146, 150.)

Length, 8.0 mm.; breadth (across broadest point which is near base of metathorax), 1.15 mm. Elongate, subparallel, and cylindrical to subtriangular in cross section. Cuticle moderately shining and brownish; antennae, mouth-parts, and legs paler brown to testaceous. *Head* at broadest point which is at basal third slightly broader than long (0.70 mm.: 0.57 mm.); coronal suture 0.07 mm. long, very broad at base and narrow anteriorly; frontal suture on each side extending in a nearly straight line to anterior margin of head near base of antenna; anterior margin between base of antenna and clypeus with a tooth-like projection which extends slightly beyond anterior margin of clypeus; surface sparsely pubescent with fine and erect hairs which are about 0.04 mm. long;

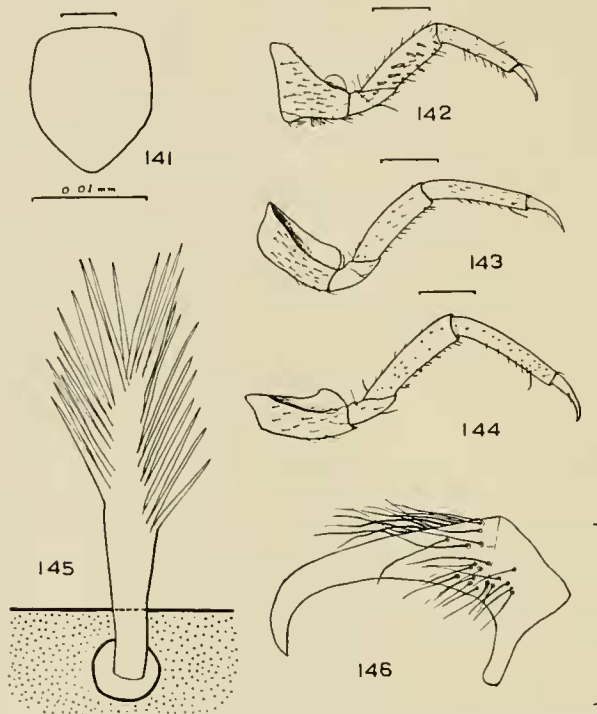


TEXT-FIGS. 137-140.—Larva of *Elstianus graniger* Sharp. (137) Ventral view of labrum. Setae of prementum are only approximately correct. (138) Ventral view of right maxilla. (139) Dorsal view of labrum. Fine setae are only approximately correct. (140) Mesothoracic spiracle.



TEXT-FIGS. 132-136.—Larva of *Elstianus graniger* Sharp. (132) Ventral view of thorax and first abdominal segment to show sclerotization. (133) Antenna. (134) Ventral view of second abdominal segment to show sclerotization. (135) Dorsal view of ninth abdominal segment. (136) Mandible.

surface finely and densely alutaceous throughout ; surface on a basal belt as long as epicranial suture only alutaceous and elsewhere set with round to feebly oblong granules which are about 0.03 mm. broad and are usually separated by once their diameters, each granule with a coarse seta which is as long or a little longer than its respective granule. *Thoracic* and *abdominal tergites* for the most part sculptured as head but with the granules slightly coarser and the alutaceous microsculpture sparse or absent ; pronotum with a number of small oval or irregular areas which are free of granules ; meso- and metanotum with these



TEXT-FIGS. 141-146.—Larva of *Elsia graniger* Sharp. (141) Operculum. (142) Anterior view of right front leg. (143) Posterior view of left middle leg. (144) Posterior view of left hind leg. (145) A seta from the ventral margin of the operculum. (146) Dorsal view of right opercular claw.

areas less numerous ; and abdominal tergites one to seven with a single anterior and lateral oval non-granulate area which is from a sixth to a fourth as long as its segment ; tergites of segments eight and nine with the granules largely replaced by punctures of the same size and density as the granules of other segments. Posterior margin of all segments except ninth with a complete ring of close tubercles from which arise flat and apically slightly branched setae (text-fig. 150). All tergites, pleurites and sternites except those of pronotum with an anterior transverse, short belt which is free of granules and is coarsely and reticulately alutaceous ; sternites of abdominal segments two to five with a complete row of close tubercles along posterior margin of this belt. Sternites and pleurites for the most part sculptured as tergites ; first abdominal sternite with the sculpture as figured (text-fig. 150). Metasternum and first abdominal sternite

with a longitudinal carina on the middle of the posterior third to fourth (text-fig. 132). Apex of ninth abdominal segment (text-fig. 135) deeply and transversely emarginate. Operculum (text-fig. 141) with the claws (text-fig. 146) not toothed. Legs as figured (text-figs. 142-144). *Spiracles* opening on small tubercles and all similar to those of mesothorax (text-fig. 140).

Specimens examined: 58, MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. 5600 ft., vi-vii. 1934 (H. E. Hinton); 4, with same data but collected at Tejupilco, alt. about 4000 ft.; and 13, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (H. E. Hinton).

Among my series there are several specimens representing at least one earlier instar, but these differ in apparently no way but size from the mature larvae.

Comparative notes: This larva may be distinguished at once from all others known by the presence of a longitudinal carina on the mesosternum and the first abdominal sternite.

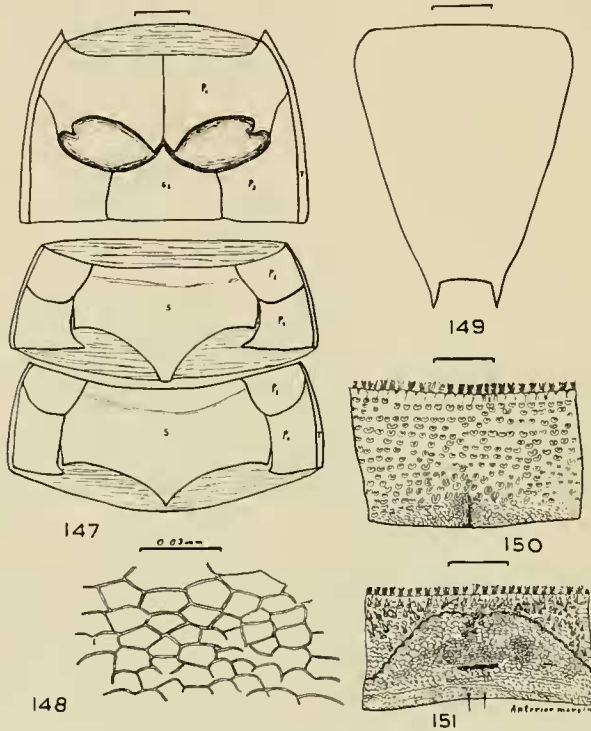
Description of Mature Larva of E. striatus.

(Text-figs. 147-149, 151.)

The larvae of this species were determined by elimination and according to locality.

Length, 9.0 mm.; breadth (across broadest point which is near base of metathorax), 1.15 mm. Elongate, subparallel, and cylindrical to subtriangular in cross section. Cuticle moderately shining and brownish; antennae, mouth-parts and legs paler brown to testaceous. *Head* across broadest point, which is at basal fourth, slightly broader than long (0.75 mm.: 0.72 mm.); posterior margin of head broadly and arcuately emarginate at middle; epicranial suture 0.05 mm. long; frontal suture extending on each side in a line which is slightly curved outwards to anterior margin opposite base of antenna; anterior margin on each side between base of antenna and clypeus with a tooth-like projection which extends slightly beyond anterior margin of clypeus and is feebly curved inwards. Cuticle sparsely pubescent with fine, erect hairs which are usually 0.075 mm. long and on each side mesal to and slightly behind eye with an erect seta which is three times this length; surface finely and sparsely or densely alutaceous, though often free of this alutaceous microsculpture; surface on a basal belt as long as epicranial suture only densely alutaceous and elsewhere with granules which are about 0.012 mm. broad and at sides of head are usually separated by once to twice their diameters, while on middle they are frequently replaced by equally small punctures which are similarly distributed; from each puncture or granule a coarse, short seta arises which is about a third longer than its respective granule or puncture. Clypeus with the fronto-clypeal suture visible but indistinct; broader and shorter than labrum; anterior margin truncate, with the angle on each side rounded; surface basally sculptured as middle region of head while on anterior middle region it is only sparsely alutaceous. Labrum as long as second antennal segment and slightly narrower than clypeus; anterior margin feebly rounded and the angle on each side broadly rounded; surface punctate and setose as middle region of head but anteriorly with fine punctures from which arise fine, erect, golden hairs which are slightly larger than the usual coarse setae. Mandibles similar to those of *graniger* but with the fine non-plumose seta on the middle of the outer margin proportionally only about half as long. Maxilla and labium fairly close to that figured for *graniger* (text-figs. 137, 138) but with the stipes of the first maxilla slightly more densely setose. *Thoracic* and

abdominal tergites for the most part sculptured as head but usually only with granules which are slightly coarser and on posterior segments have the apices acute and produced; pronotum with a number of irregularly oval areas which are free of granules; meso- and metanotum with a similar oval area on lateral fourth and another on lateral two-fifths; and first eight abdominal tergites with a similar area on lateral fourth which may vary from being a sixth to a fourth as long as its respective segment. Posterior margin of all segments except ninth with a complete ring of close tubercles from which arise flat and apically slightly branched



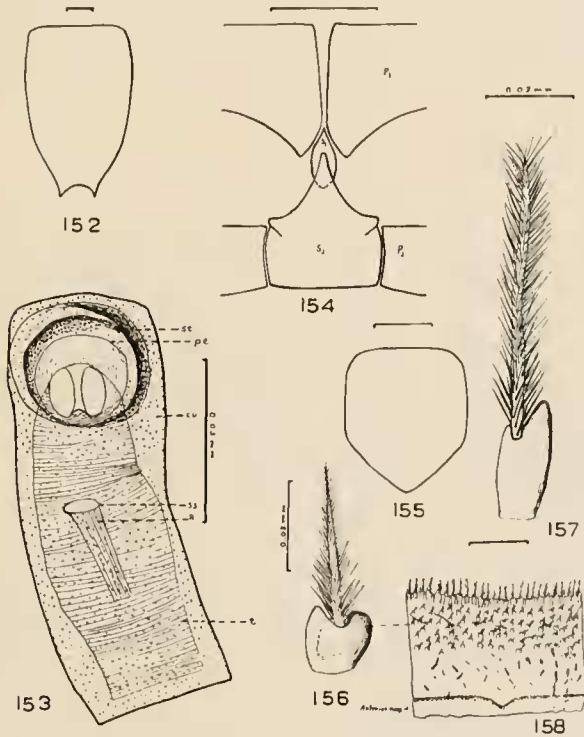
TEXT-FIGS. 147-151.—(147) Ventral view of thorax of larva of *Elysianus striatus* Sharp to show sclerotization. (148) Reticulate sculpture of anterior region of first abdominal sternite of same. (149) Dorsal view of ninth abdominal tergite of same. (150) Sternite of first abdominal segment of *E. graniger* Sharp. (151) Sternite of first abdominal segment of *E. striatus*.

setae (text-fig. 151). All tergites, pleurites, and sternites except those of pronotum with an anterior transverse belt which is usually free of granules and is coarsely and reticulately alutaceous; this belt is generally about a fourth to a third as long as its respective segment but that of ninth is less than a sixth as long as that segment; all sternites except that of prosternum and ninth abdominal segment with a complete and transverse heavily sclerotized belt or ridge along posterior margin of reticulate belt. Sternites and pleurites with acute tubercles similar to tubercles of tergites; first abdominal sternite sculptured as figured (text-fig. 151). Postero-lateral angles of all abdominal segments strongly and acutely produced. Apex of ninth abdominal tergite (text-fig. 149) deeply and truncately emarginate. Operculum with the claws not toothed and at base on dorsal surface

with a number of very long, fine, recumbent hairs. *Legs* similar in size and shape to those figured for *graniger* but with the chaetotaxy slightly different. *Spiracles* similar to those of *graniger*.

Specimens examined: 103, MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vii. 1934 (*H. E. Hinton*); and 13, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*).

Included in this material there are specimens representing at least two earlier instars, but these differ apparently only in size from the mature larvae.



TEXT-FIGS. 152-158.—Larva of *Elsianus* sp. ? (152) Dorsal view of ninth abdominal segment. (153) Spiracle of first abdominal segment. (154) Prosternum. (155) Operculum. (156) One of the usual tubercles of the first abdominal sternite. (157) A tubercle from the posterior marginal row of the fifth abdominal tergite. (158) First abdominal sternite.

Comparative notes: This species may be distinguished from *E. graniger* in not having a longitudinal carina on the metasternum and first abdominal sternite. The sculpture of the first abdominal sternite (text-fig. 151) differs markedly from all species known to me.

Description of Mature Larva of Elsianus sp. ?.

(Text-figs. 152-158.)

Length, 9.0 mm.; breadth (across broadest point which is near base of metathorax), 1.12 mm. Resembles *striatus* but may be distinguished as follows: (1) thoracic and abdominal tergites with the setae which arise from the tubercles plumose and not smooth; (2) posterior margin of all segments except ninth with

a complete ring of close tubercles from each of which arises a long, round, and densely hairy seta, instead of, as in *striatus*, a flat seta with a few apical branches; (3) middle of anterior margin of posterior prosternal sclerite very strongly instead of moderately produced (*cf.* text-figs. 154 and 147); (4) anterior angles of posterior prosternal sclerite (text-fig. 154) strongly produced and rounded, whereas in *striatus* they are not produced and are angulate; (5) sternite of first abdominal segment with the anterior reticulate belt at middle confined to anterior fifth of sternite whereas in *striatus* it extends to posterior fourth; and (6) apex of ninth abdominal segment (text-fig. 152) slightly arcuately instead of truncately emarginate.

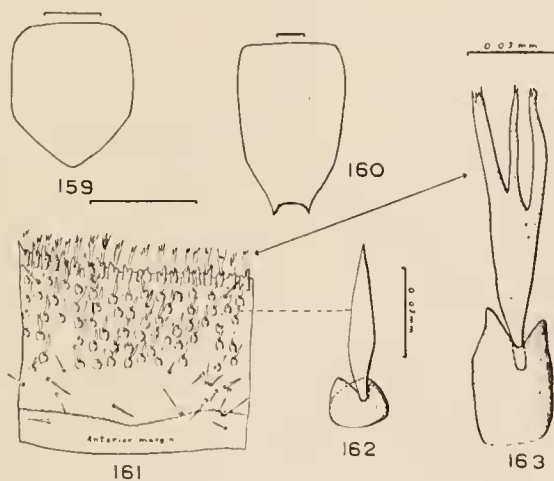
Specimen examined: 1, apparently mature larva. MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. 5600 ft., vii. 1934 (*H. E. Hinton.*)

Description of Mature Larva of Elsianus (?) sp. ?.

(Text-figs. 159-163.)

Length, 8.5 mm.; breadth (across broadest point which is near base of metathorax), 0.82 mm. Elongate, subparallel, and cylindrical to subtriangular in cross section. Cuticle feebly shining and brownish-testaceous; antennae, mouth-parts, and legs paler testaceous. *Head* across broadest point which is at basal fourth broader than long (0.75 mm.: 0.65 mm.); posterior margin of head at middle very broadly and only feebly arcuately emarginate; epicranial suture 0.12 mm. long and narrow; frontal suture on each side extending in a moderately sinuate line to anterior margin opposite base of antenna; anterior margin on each side between base of clypeus and antenna with a large and straight tooth which is nearly twice as long as clypeus. Cuticle sparsely pubescent with fine, erect hairs which are usually 0.15 mm. long; surface on a basal belt as long as epicranial suture smooth to moderately densely alutaceous and without distinct granules or punctures; surface elsewhere occasionally moderately densely alutaceous though usually smooth and with flat round granules which are about 0.03 mm. broad and are separated mostly by once their diameters; from these granules arise setae which are about as long or a little longer than their respective granules; surface of head with the area enclosed by the frontal sutures, except for a small antero-lateral area on each side, free of granules. Antennae retractile up to apex of first segment. Clypeus with the fronto-clypeal suture visible; broader than labrum and as long as second segment of antenna; anterior margin truncate and with the angle on each side rounded; surface, except at sides where there are a few granules, free of granules and sculptured as frontal region of head. Labrum narrower and slightly shorter than clypeus; anterior margin nearly truncate and with the angle on each side broadly rounded; surface similar to that of clypeus but near middle with a complete transverse row of close, fine, erect hairs which are slightly shorter than usual ones of head. Mandibles with the seta on middle of outer margin proportionally as long as that of *graniger*. First and second maxilla in general form similar to that figured for *graniger*, but with the apical region of the postmentum about a fourth broader than the basal. *Pronotum* with the surface similar to that of frontal region of head but with the erect setae generally about a fourth longer, and at anterior third there is a short (about two granules wide) transverse belt of tubercles which extends from lateral margin on each side of the middle third of pronotum; lateral margins basally and anteriorly with a few granules similar to those of head; meso- and metanotum similar but with the transverse band at middle three times as long (four to six

granules broad) and extending right across middle, though basally interrupted at lateral third; first three abdominal tergites with only a short posterior belt and an oval lateral area, which is about a third as long as any segment, free of granules; tergites four to seven without a posterior belt free of tubercles but with the lateral, oval, non-tuberculate area present; tergites eight and nine without the lateral, oval, non-tuberculate area. Anterior reticulate or coarsely alutaceous belt of tergites, pleurites, and sternites present on all segments except pronotum, usually about a fifth as long as any segment, and along posterior margin with a complete transverse heavily sclerotized ridge which may or may not be tuberculate and is present except on pleurites, though on eighth and ninth segments it forms a complete ring; on abdominal segments one to seven it is on the sternites arcuately



TEXT-FIGS. 159-163.—Larva of *Elsianus* (?) sp. ? (159) Operculum. (160) Dorsal view of ninth abdominal segment. (161) First abdominal sternite. (162) Tubercle from first abdominal sternite. (163) Tubercle from posterior marginal row of first abdominal sternite.

curved so that at middle it is nearer anterior margin than elsewhere. Posterior margin of all segments except ninth abdominal with a complete ring of close, large tubercles from which arise flat setae which are about twice as long as their respective tubercles and are branched apically (text-figs. 161 and 163). First abdominal sternite sculptured as figured (text-fig. 161). Anterior margin of posterior prosternal sclerite similar to that of *striatus* (cf. figure). Posterior margin of meso- and metasternum strongly and acutely produced. Pleurae of abdominal segments two to seven longitudinally not divided and tergo-pleural suture ventral. Postero-lateral angles of tergites rounded and not produced. Apex of ninth abdominal segment (text-fig. 160) broadly, deeply, and arcuately emarginate. Operculum (text-fig. 159) with the claws not toothed and at base on dorsal surface with a number of very long, fine, recumbent hairs. *Legs* similar in shape and size to those figured for *E. graniger*. *Spiracles* similar to those of *graniger* and *striatus*.

Specimens examined: 3, apparently mature larvae, MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. 5600 ft., vii. 1934 (*H. E. Hinton*).

Comparative notes: This is the only species of about 15 I have examined

belonging to this genus which has not the pleurae of abdominal segments two to seven longitudinally divided. It may possibly belong to a genus as yet unrecorded from Mexico.

AUSTROLIMNIUS Carter & Zeck.

1929. *Austrolimnius* Carter & Zeck, *Aust. Zool.*, 6 (1) : 61.

1929. *Neosolus* Carter & Zeck, *Aust. Zool.*, 6 (1) : 68.

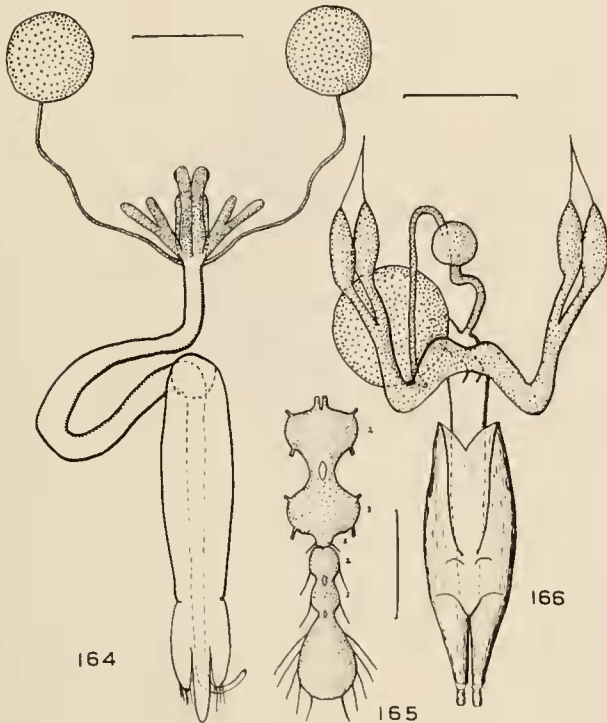
1932. *Austrolimnius* Carter & Zeck, *Aust. Zool.*, 7 (3) : 204.

Carter and Zeck (1929) in their monograph of the Australian Dryopidae erected the genus *Austrolimnius* to contain two species described by King (1865) in the genus *Elmis* Latreille and two new species. In the same monograph they erected the genus *Neosolus* to contain a single new species, *N. tropicus*. *Neosolus* was later (1932) sunk by them as a synonym of *Austrolimnius*. Altogether ten species and three varieties have been described from Australia. The following North and South American species should be referred to *Austrolimnius*: *A. chiloensis* (Champion) (*Elmis prothoracica* Hinton); *A. curtulus* (Sharp) (*Elmis*); *A. formosus* (Sharp) (*Elmis*); *A. laevigatus* (Grouvelle) (*Elmis*); *A. pilulus* (Grouvelle) (*Elmis*); and *A. sulcicollis* (Sharp) (*Elmis*). Altogether eight species are known from North and South America, and of these two have been collected as far north as Mexico, *A. formosus* and *A. sulcicollis*.

A redescription of the genus follows :

Body obovate to subparallel. Dorsal surface glabrous or clothed with sparse and short recumbent hairs. Tomentum confined to the following areas : (1) genae ; (2) epipleura ; (3) occasionally (*A. luridus* C. and Z. and *A. minutus* Hinton) sides of elytra between inner margin of epipleura and outer sublateral carina ; (4) hypomera ; (5) sides of prosternum, mesosternum, metasternum, and abdominal sternites, but in some species nearly the entire sternum of the abdomen is clothed with fine tomentum ; (6) part or all of legs except tibiae and tarsi. *Head* when seen from below capable of being retracted so that none of the mouth-parts are visible. Antennae 11-segmented. Mandibles with three apical blunt teeth ; prostheca large and entirely membranous with numerous fine spines or hairs apically. Maxilla with the palp 4-segmented and stipes with a well-developed palpifer ; galea and lacinia separate and apex of each densely spinose. Labium with the palp 3-segmented and prementum with a well-developed palpiger. Mentum transverse and about as broad as and two-thirds to three-fourths as long as submentum. Gula slightly narrower than submentum, about a third longer, and with the sides nearly parallel. *Pronotum* with the anterior margin moderately to strongly arcuate at middle and on each side behind eye before apical angle shallowly to deeply sinuate. Base trisinuate, broadly and moderately deeply so on each side and more narrowly and shallowly so in front of scutellum. Pronotum with a sublateral carina on each side which extends from base nearly to apical margin and may or may not be prominent ; disk with or without a median longitudinal impression. *Elytra* impunctate or with distinct seriate punctures but seldom with striae which if present are only very feebly impressed ; each elytron with two prominent sublateral carinae. Epipleura with a longitudinal line of granules which on anterior two-fifths is halfway between dorsal and ventral margins, while on posterior three-fifths it is close to and parallel to ventral margin. Hind wings with the venation much reduced ; with a well-developed anal lobe (text-fig. 168) ; without a radial cross vein and without an anal cell ; first anal absent ; second anal without

branches ; third anal only present basally and joined to second anal at extreme base ; fourth anal short and indistinct ; and cubito-anal cross vein arising from second anal at about the middle of the length of the latter but not complete to cubitus. Prosternum very long in front of anterior coxae ; prosternal process long and very broad and posterior margin broadly rounded. Mesosternum with a broad and deep groove for the reception of the prosternal process. Metasternum with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae rounded and trochantin completely concealed by hypomera and



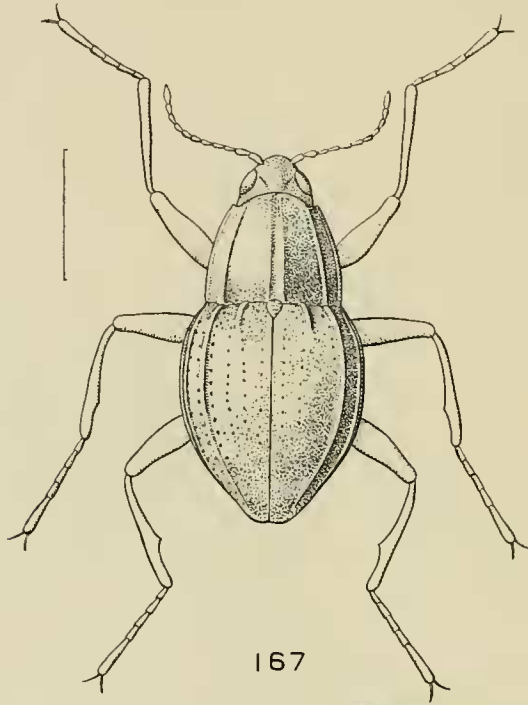
TEXT-FIGS. 164-166.—*Austrolimnius tarsalis* Hinton. (164) Male reproductive system. (165) Central nervous system. (166) Female reproductive system.

sternum. Claws without teeth. *Alimentary canal* with five caeca on the anterior margin of the mid-gut. Hind gut with six Malpighian tubules which end near the rectum freely or embedded in fatty tissue. *Male reproductive system* (text-fig. 164) with the lateral accessory glands with several lobes. Each testis with only one sperm tube. *Female reproductive system* (text-fig. 166) with two egg tubes to each ovary. Spermathecal duct opening posteriorly to bursa copulatrix. *Central nervous system* (text-fig. 165) with three thoracic discrete ganglia. First abdominal ganglion fused to third thoracic, two and three free, and four to eight fused into a single large ganglion.

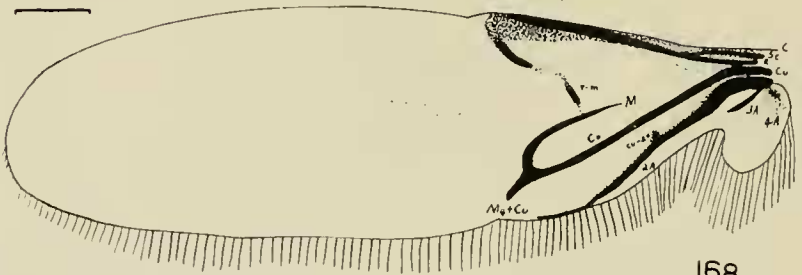
GENOTYPE: *Elmis politus* King.

The internal anatomy of only one species, *A. tarsalis* Hinton, has been examined.

This genus is close to *Limnius* Erichson, but may be distinguished as follows : the middle region of the head is without tomentum ; Carter and Zeck (1929 : 61) claim that there is no tomentum on the head in *Austrolimnius*, but the genae are clearly tomentose in their genotype and in seven other species I have been able to examine for this character ; (2) there is no tomentum on the pronotum.



167



168

TEXT-FIGS. 167, 168.—*Austrolimnius sulcicollis* Sharp. (167) Adult to show general appearance. (168) Hind wing. Venation after Forbes.

between the lateral margin and the sublateral carina, whereas in *Limnius* tomentum, at least anteriorly, is usually present here ; (3) the elytron between the first and second sublateral carinae is never tomentose, whereas in *Limnius* it is usually at least partly tomentose ; (4) the hind wing has a very well-developed anal lobe, whereas in *Limnius* the anal lobe is at most only very feebly developed ; (5) the second anal extends to inner margin of wing opposite junction of cubitus and media, whereas in *Limnius* the second anal is present only basally ; (6) in

Austrolimnius there is an incomplete cubito-anal cross vein, while in *Limnius* there is no trace of such a vein; (7) the male reproductive system has only one sperm tube to each testis, whereas in *Limnius* it has two sperm tubes; and (8) the central nervous system has only the second and third abdominal ganglia free, whereas in *Limnius*, the second, third, and fourth are free.

The specific characters of most importance in separating the species of *Austrolimnius* seem to be the following:

- (1) General proportions, length and breadth.
- (2) Colour. In some species, e.g. *luridus*, *suffusus*, etc., the elytra are maculate.
- (3) Density of the asperate microsculpture on the various sclerites.
- (4) Size and distribution of punctures and tubercles on the various sclerites.
- (5) Condition of fronto-clypeal suture.
- (6) Anterior margin of clypeus, whether rounded, truncate, emarginate, or sinuate; and also angle on each side.
- (7) Condition of anterior margin of labrum and the angle on each side.
- (8) Outline of pronotum. Shape and extent of sublateral carina. Extent and depth of median longitudinal impression if one is present.
- (9) Shape of elytral apices.
- (10) Condition of lateral margin of elytra (inner margin of epipleura), whether crenate or smooth.
- (11) Number and extent, if any, of carinate intervals.
- (12) Condition of epipleura. Form and extent of carina parallel to inner margin if one is present.
- (13) Shape of scutellum.
- (14) Condition of prosternal carinae.
- (15) Condition of anterior portion of prosternum, whether straight or lobed when viewed laterally.
- (16) Extent and depth of mesosternal groove.
- (17) Disk of metasternum, whether flat or not and extent and depth of the various impressions.
- (18) Extent and prominence of carina on each side of metasternal disk.
- (19) Length and prominence, if present, of carina of first abdominal sternite.
- (20) Shape of fifth abdominal sternite.
- (21) Secondary sexual characters.
- (22) Structure of male genitalia. No case is known where these structures are the same for two or more species.

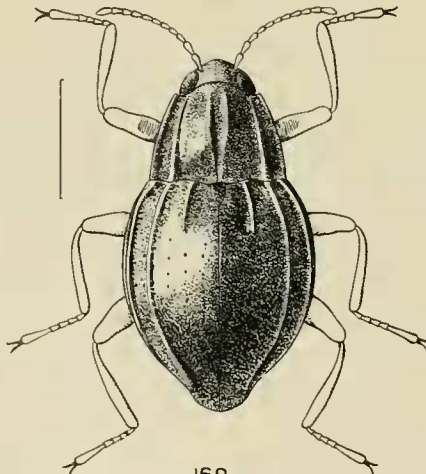
The following are the secondary sexual characters that have been noted by previous authors and those noted by the writer for the first time:

- (1) Male with numerous very long, fine, recumbent, golden hairs on each side of clypeus (*formosus*).
- (2) Male with a dense tuft of long, fine, recumbent, golden hairs on anterior side of metasternal disk (*formosus*).
- (3) Male with the inner apical fifth of the front tibia swollen (*montanus*).
- (4) Male with the front tarsi dilated (*oblongus*).
- (5) Male with numerous very fine and long hairs on ventral surface of four basal segments of front tarsi (*tarsalis*).
- (6) Male with the inner apex of the middle tibia acutely produced (*oblongus*).
- (7) Male with the middle tibiae on inner apical two-fifths swollen and here also with a few fine teeth (*victoriensis*, *oblongus*, *sulcicollis*).

- (8) Male with a row of short and stout teeth on inner apical half of middle tibia (*diemenensis*, *oblongus*).
- (9) Male with the inner apical spur of middle tibia strongly curved inwards (*diemenensis*).
- (10) Male with a few large and acute teeth on inner margin of hind trochanter (*sulcicollis*).
- (11) Male with, on outer apical fourth of hind tibia, a row of long, fine teeth and posterior to these with a few short and stout teeth (*diemenensis*).
- (12) Male with a long and acute tooth on inner apical two-fifths of hind tibia (*sulcicollis*).
- (13) Male with the inner part of apical two-fifths of hind tibia swollen (*tarsalis*).
- (14) Male with the shape of the fifth abdominal sternite different to that of female (*formosus*).
- (15) Male with the surface of the fifth abdominal sternite less strongly granulate than that of female (*formosus*).
- (16) Male with the sixth abdominal sternite differently shaped to that of female (all species).
- (17) Male with the last dorsal abdominal tergite differently shaped to that of female (*formosus*).

A KEY TO THE NORTH AMERICAN SPECIES OF *Austrolimnius*.

1. Elytra without carinate discal intervals. GUATEMALA. MEXICO.
A. formosus (Sharp) (1882).
- Elytra with the third discal interval strongly carinate at base 2.
2. Pronotum with the median longitudinal channel about as broad at apex as at base. PANAMA, MEXICO *A. sulcicollis* (Sharp) (1882).
- Pronotum with the median longitudinal channel twice as broad on apical three-fifths as at base (text-fig. 169). PANAMA
A. curtulus (Sharp) (1882).



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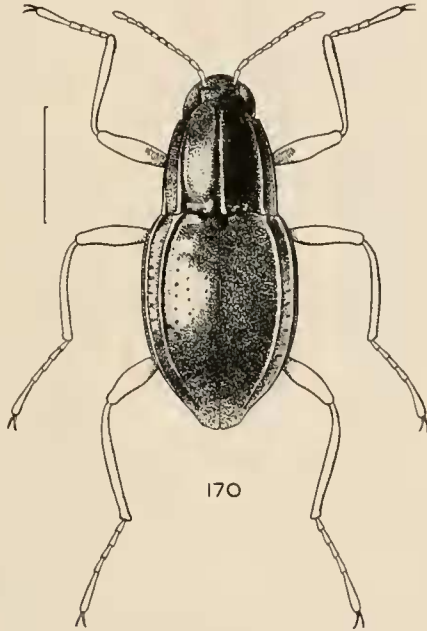
TEXT-FIG. 169.—*Austrolimnius curtulus* Sharp.

***Austrolimnius formosus* (Sharp).**

(Text-figs. 170-180.)

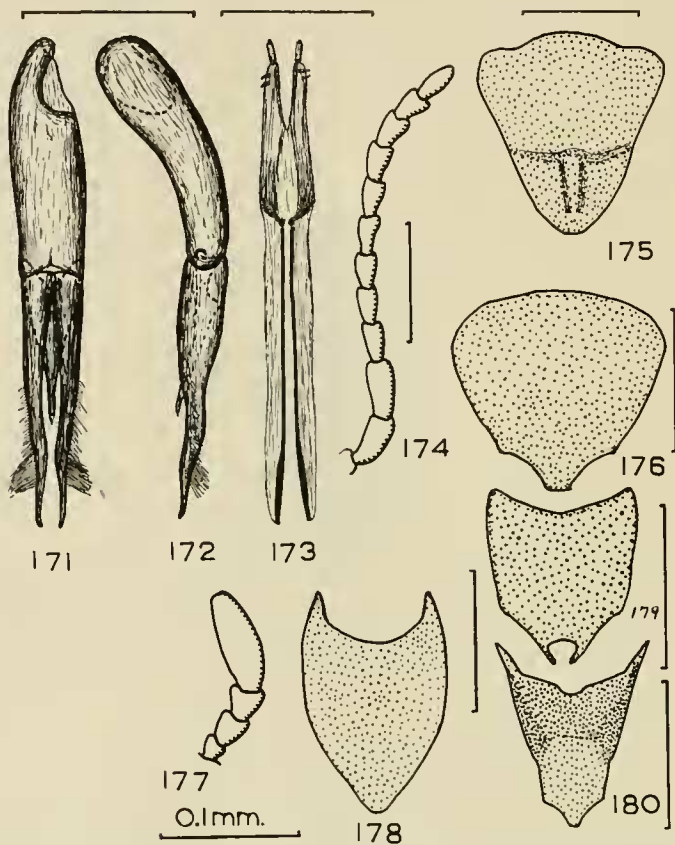
1882. *Elmis formosus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 140.1936. *Austrolimnius formosus* Hinton, *Trans. R. Ent. Soc. Lond.*, 85 (18) : 420.

Male: Length, 1.3 mm.-1.5 mm.; breadth, 0.62 mm.-0.75 mm. Cuticle moderately strongly shining and black; antennae, mouth-parts, and legs rufopiceous. *Head* without distinct impressions; surface densely and finely asperate and without distinct granules or punctures. Clypeus with the fronto-clypeal suture straight and rather indistinct at middle; anterior margin truncate to very feebly rounded for its entire breadth and angle on each side very broadly

TEXT-FIG. 170.—*Austrolimnius formosus* Sharp.

rounded; surface asperate as on head and on each side with a dense tuft of fine, golden-testaceous, recumbent hairs which are about 0.10 mm. long. Labrum with the anterior margin broadly, arcuately, and moderately deeply emarginate at middle, and with the angle on each side prominent but obtusely rounded; surface slightly more sparsely asperate than that of clypeus; at sides with numerous fine hairs which are similar but generally shorter than those of clypeus. *Pronotum* across broadest point, which is at basal third, not quite as broad as long (0.53 mm. : 0.55 mm.) and base broader than apex (0.52 mm. : 0.32 mm.). Pronotum with the carina and impressions as figured (text-fig. 170). Surface asperate as head but more evenly so. *Elytra* nearly twice as long as pronotum (1.02 mm. : 0.55 mm.) and broadest point which is across middle (0.68 mm.) and very slightly broader than broadest point across humeri. Lateral margins (*i.e.* inner margins of epipleura) nearly smooth. Apices conjointly produced and rounded. Surface without striae; with three discal rows of seriate punctures of which the outer two extend from basal fourth to apical fifth and basally are round, about

0.024 mm. broad, and separated longitudinally by two to three times their diameters; towards apex these punctures become slightly denser and coarser; inner row of punctures similar to outer rows but not beginning until basal two-fifths and extending slightly nearer to apex. Surface between punctures more finely and much more sparsely asperate than that of pronotum. Inner side of inner sublateral carina with a complete row of coarse, less distinct,



TEXT-FIGS. 171-180.—*Austrolimnius formosus* Sharp. (171) Dorsal view of male genitalia. (172) Left lateral view of same. (173) Female genitalia. (174) Antenna. (175) Ventral view of fifth abdominal sternite of male. (176) Ventral view of fifth abdominal sternite of female. (177) Maxillary palp. (178) Apical abdominal tergite of male. (179) Apical abdominal tergite of female. (180) Sixth abdominal sternite of male.

and sparser punctures; between sublateral carinae and between inner margin of epipleura and outer sublateral carina with punctures which are indistinct about two to three times as coarse as those of disk, and are separated by once to twice their diameters. Epipleura from humeri to apical sixth with a row of fine (about as coarse as facets of eye) close granules parallel and close to inner margin of epipleura. *Scutellum* flat, subovate, longer than broad (0.10 mm. : 0.75 mm.), base broadly rounded, and narrowed to apex and at apex feebly rounded; surface asperate as adjacent parts of elytra. *Prosternum* with the carinae prominent

and extending nearly to anterior margin; when viewed laterally the anterior half (not including process) is moderately but not sharply bent ventrally; surface of middle and of process asperate as pronotum, while the surface of the sides and hypomera is asperate as that of head. Mesosternum with the groove for the reception of the prosternal process broad and deep but not extending beyond posterior third; surface asperate on each side as that of prosternal process. Metasternum with the median longitudinal line feebly impressed and extending nearly to anterior fourth; disk anteriorly nearly flat and with the posterior third moderately strongly convex; disk on each side with a prominent carina which extends posteriorly and slightly outwards from middle coxa nearly to hind coxa; surface asperate as disk of elytra and on each side near anterior fourth of discal carina with a dense tuft of fine, recumbent, golden testaceous hairs which are about 0.05 mm. long; sides of metasternum asperate as pronotal disk. Abdomen with the first sternite without carinae; surface of sternites one to four asperate as metasternal disk; fifth sternite (text-fig. 175) more densely asperate and also with a few obscure granules. *Genitalia* as figured (text-figs. 171, 172).

Female: Externally similar to male except as follows: (1) there is no dense tuft of fine and long hairs on each side of the clypeus; (2) there is no dense tuft of fine and long hairs on each side of the metasternal disk near anterior fourth of discal carina; (3) the fifth abdominal sternite is shaped differently (cf. text-figs. 176 and 175); (4) the surface of the fifth abdominal sternite is more densely and distinctly granulate than that of the male, the granules being here about as coarse as facets of eyes and separated by two to three times their diameters; and (5) the last dorsal abdominal segment is differently shaped (cf. text-figs. 179 and 178).

Type: In the British Museum (Nat. Hist.). GUATEMALA: Vera Paz, San Joaquin (*Champion*).

Specimens examined: 1, with same data as type. 18, MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vi. 1933 (*H. E. Hinton, R. L. Usinger*); 1, in the same district, Real de Arriba, alt. about 7000 ft., 28.v. 1933 (*H. E. Hinton, R. L. Usinger*); and 21, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*).

Variations: No variations, apart from absolute size, have been noted.

Comparative notes: This species may be easily distinguished from its only Mexican congener and the only other North American species of the genus by the absence of a basal carina on the third discal clytral interval.

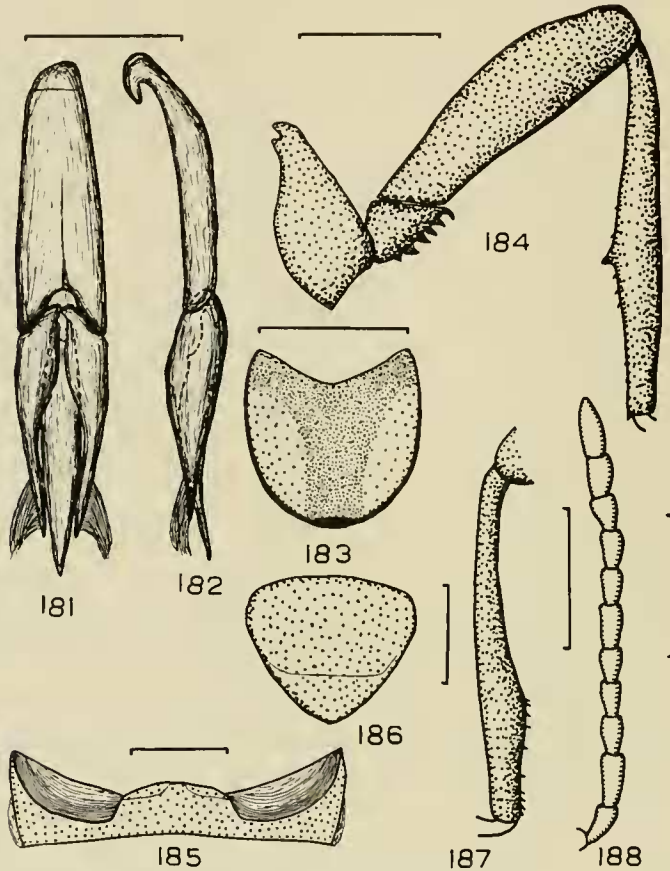
***Austrolimnius sulcicollis* (Sharp).**

(Text-figs. 167, 168, 181-188.)

1882. *Elmis sulcicollis* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 139, t. 4, f. 16.

Male: Length, 1.3 mm.-1.4 mm.; breadth, 0.70 mm.-0.77 mm. Cuticle moderately shining and rufo-piceous to black; antennae, mouth-parts, and legs paler rufo-piceous. Head without distinct impressions; surface densely and very finely asperate and without granules or punctures. Clypeus with the frontoclypeal suture straight and rather indistinct at middle; anterior margin truncate and angle on each side broadly rounded; surface asperate as head and on each side with a few fine, recumbent, golden-testaceous hairs which are about 0.05 mm. long. Labrum with the anterior margin broadly and very feebly rounded and with the angle on each side broadly rounded; surface slightly more sparsely

asperate that that of clypeus and on each side with a dense tuft of hairs each of which is similar to those of clypeus. *Pronotum* with the broadest point, which is across base and equally across basal third, slightly broader than long (0.55 mm. : 0.50 mm.) and base broader than apex (0.55 mm. : 0.33 mm.). *Pronotum* with the carinae and impressions as figured (text-fig. 167). Surface asperate as head but, particularly on disk, more sparsely and evenly so. *Elytra* twice as long as



TEXT-FIGS. 181-188.—*Austrolimnius sulcicollis* (Sharp). (181) Dorsal view of male genitalia. (182) Left lateral view of same. (183) Last dorsal abdominal segment of male. (184) Hind leg of male. (185) First abdominal sternite. (186) Fifth abdominal sternite of male. (187) Middle tibia of male. (188) Antenna.

pronotum (1.00 mm. : 0.50 mm.) and broadest point which is across middle only slightly broader than broadest point across humeri (0.70 mm. : 0.72 mm.). Lateral margins nearly smooth. Apices broadly produced and conjointly rounded. Surface without striae but with three discal rows of seriate punctures of which the two outer begin on about basal third and extend to apical sixth, while the inner row begins at about basal half and extends nearly to apex ; on disk these punctures are two-thirds as coarse to a third coarser than facets of eyes and are usually separated by two to three times their diameters ; anterior

half of inner row with the punctures distinctly finer than corresponding punctures of outer rows; surface between punctures finely, indistinctly, and much more sparsely asperate than those of pronotal disk. Inner side of inner sublateral carina with a complete row of coarse, less distinct, and more irregularly distributed punctures; area between sublateral carinae with punctures about two to three times as coarse as discal ones, often indistinct, separated by once to twice their diameters, and near apex partly arranged in two rows. Third discal interval carinate on basal fifth. Epipleura from basal fourth to apical fifth with a feeble ridge parallel and very close to inner margin. *Scutellum* flat, subovate, longer than broad (0.10 mm. : 0.07 mm.), base broadly rounded, and narrowed to and feebly rounded at apex; surface asperate as adjacent parts of elytra. *Prosternum* with the carinae prominent and extending nearly to anterior margin; when viewed laterally the anterior half (not including process) is only feebly and gradually bent ventrally; surface of middle and of process asperate as disk of elytra but slightly more densely so, while the surface of sides and hypomera is about as densely asperate as head. *Mesosternum* with the groove for the reception of the prosternal process broad and very deep and not extending to posterior fourth; surface asperate as hypomera. *Metasternum* with the median longitudinal line feebly impressed and extending nearly to anterior fourth; disk only very feebly convex at sides on posterior half; disk on each side with a fine and feebly raised carina which extends posteriorly and slightly outwards from middle coxa nearly to posterior coxa; surface of disk asperate as disk of elytra; sides of metasternum asperate as densely as sides of prosternum. Abdomen without carinae on the first sternite; sternites one to four asperate as metasternal disk; fifth sternite asperate as hypomera. *Legs* with middle tibia near apical fourth swollen on inner side and with a row of fine short teeth (text-fig. 187). Hind trochanter with an inner row of six stout, short, and acute teeth (text-fig. 184); hind tibia on inner apical two-fifths with a large but short acute tooth. *Genitalia* as figured (text-figs. 181, 182).

Female: Externally similar to male except as follows: (1) the inner apical fourth of the middle tibia is not swollen and there is here no row of short and stout teeth; (2) the hind trochanter is smooth and not toothed along its inner margin; and (3) there is no tooth on the inner apical two-fifths of the hind tibia.

Type: ♂ in the British Museum (Nat. Hist.). PANAMA: Volcan de Chiriquí, alt. 2000–3000 ft. (*Champion*).

Specimens examined: 5, with same data as type but collected between 4000 and 6000 ft.; 1, MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., 15.vi.1933 (*H. E. Hinton, R. L. Usinger*); and 8, at same locality as above but collected in vii.1934 (*H. E. Hinton*).

Variations: No variations worthy of mention have been noted in the small series before me.

Comparative notes: This species can be compared only with *A. curtulus* (Sharp) of Panama but may easily be distinguished by having the pronotal channel as broad at apex as at base, whereas in *curtulus* this channel is twice as broad at apex as at base.

XENELMIS Hinton.

1936. *Xenelmis* Hinton, *Trans. R. Ent. Soc. Lond.*, **85** (18): 427.

The following species should be referred to *Xenelmis*: *X. granata* (Grouv.) (*Elmis*) and *X. micros* (Grouv.) (*Elmis*). Five species of this genus are now

known, one from Mexico and four from Brazil. A redescription of the genus follows :

Body broadly oval. Non-tomentose areas clothed with sparse and short recumbent hairs ; fine scale-like or hairy tomentum confined to the following areas : (1) pronotum ; (2) epipleura ; (3) hypomera ; (4) sides of prosternum, mesosternum, metasternum, and abdominal sternites, but occasionally the entire sternum of the abdomen is clothed with scale-like tomentum ; and (5) part of all of legs except tarsi. *Head* when seen from below capable of being retracted so that none of the mouth-parts are visible. Antennae 11-segmented. Mandibles with three apical blunt teeth ; prosthema entirely membranous and with a few fine spines or hairs apically. Maxilla with the palp 4-segmented and stipes with a well-developed palpifer ; galea and lacinia separate and apex of each with spines. Labium with the palp 3-segmented and prementum with a well-developed palpiger. Mentum transverse and as broad as but only half as long as submentum. Gula about as broad as submentum, nearly a fourth longer, and with the sides parallel. *Pronotum* with the anterior margin strongly arcuate at middle and on each side behind eye before apical angle deeply and broadly sinuate. Pronotum without sublateral carinae and disk without a median longitudinal channel ; base trisinate, broadly and moderately deeply so on each side and more narrowly and shallowly so in front of scutellum. *Elytra* punctate and striate ; each elytron with two sublateral carinae each of which is formed by a row of close granules. Hind wing (text-fig. 192) without a radial cross vein or an anal cell ; first anal absent ; second anal without branches ; third anal only present basally and at its apex joined to second anal at about apical two-fifths of the latter's length ; fourth anal well-developed ; and cubito-anal cross vein absent. *Prosternum* moderately short in front of anterior coxae ; prosternal process long and very broad and with the posterior margin broadly rounded. Mesosternum with a deep and very broad groove for the reception of the prosternal process. Abdomen with the middle posterior margin of the first sternite very broad and nearly truncate. Metasternum with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae rounded and trochantin completely concealed by the hypomera and sternum. Claws without teeth. *Alimentary canal* (text-fig. 191) without caeca on the anterior margin of the mid-gut. Hind gut with six Malpighian tubules which end freely near the rectum. *Male reproductive system* with the lateral accessory glands simple and not lobed. Each testis with two sperm tubes. Female reproductive system (text-fig. 189) with at least four egg tubes to each ovary. Spermathecal duct opening into apex of bursa copulatrix (the duct then continuing in wall of bursa copulatrix so that it appears actually to open near the uterus). *Central nervous system* with three discrete thoracic ganglia. First abdominal ganglion partly fused at base to third thoracic, second free, third partly fused at apex to terminal ganglion, and four to eight fused into a single large terminal ganglion.

GENOTYPE : *Elmis bufo* Sharp (1882).

Only one species, *X. tarsalis* Hinton, has been available for an examination of the internal anatomy.

This genus seems to be most closely related to *Limnius* Erichson, but may be distinguished as follows : (1) the head is without tomentum ; (2) the disk of the pronotum is tomentose whereas in *Limnius* the pronotal tomentum is confined to the sides between lateral margin and sublateral carina ; (3) the elytra are without tomentum, whereas in *Limnius* they are often tomentose to inner sublateral carina ; (4) there are no sublateral carinae on the pronotum ; (5) the hind wing has the

second anal extending to inner margin of hind wing opposite junction of cubitus and media, whereas in *Limnius* the second anal is present only basally; (6) the alimentary canal has no caeca on anterior margin, whereas in *Limnius* caeca are here present; and (7) the central nervous system has the fourth abdominal ganglion fused to the terminal mass, whereas in *Limnius* the fourth is free. It may be distinguished from *Xenelmoides* Hinton by its broadly oval instead of subparallel body, the absence of tomentum on the genae, and the much broader and nearly truncate middle posterior margin of first abdominal sternite.

The specific characters of greatest importance in separating the species of *Xenelmis* appear to be the following:

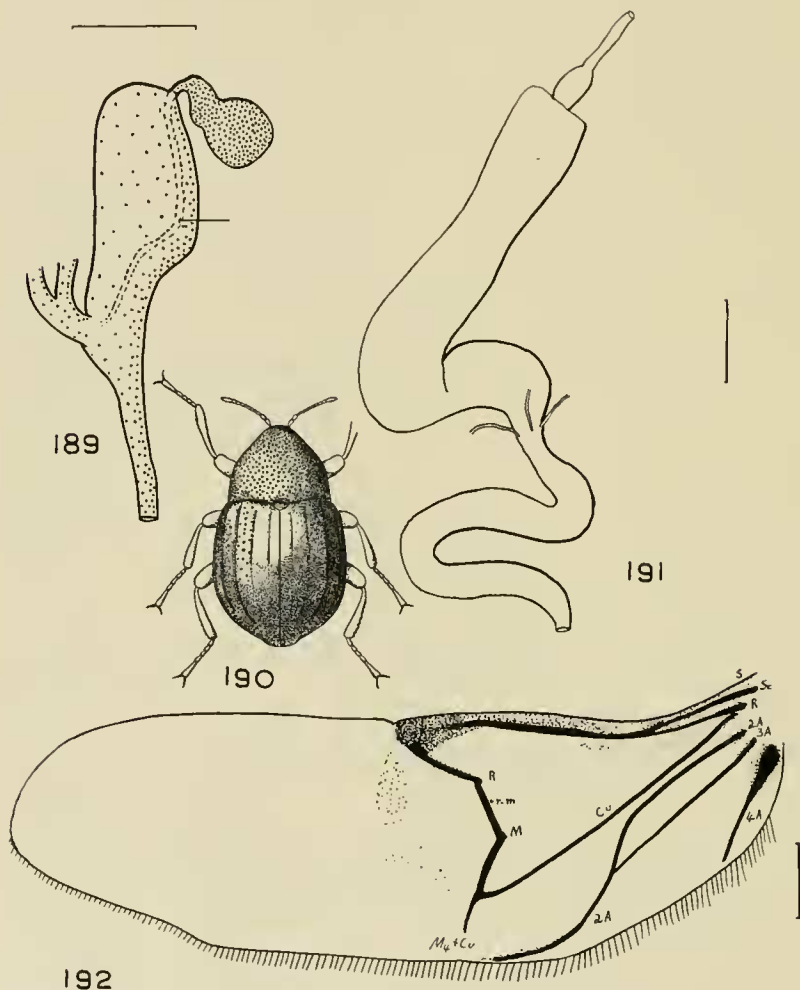
- (1) General proportions, length and breadth.
- (2) Colour. In some species the surface of the pronotum is a different colour to that of the elytra.
- (3) Density of the tubercles and punctures on the various sclerites.
- (4) Distribution of the alutaceous microsculpture.
- (5) Length and shape of carinae, if present, on head.
- (6) Condition of fronto-clypeal suture.
- (7) Anterior margin of elypeus, whether rounded, truncate, emarginate or sinuate; and also shape of angle on each side.
- (8) Shape and distribution of rows of granules, if present, on pronotal disk.
- (9) Shape of anterior margin of labrum and that of the angle on each side.
- (10) Condition of lateral margin of elytra (inner margin of epipleura), whether crenate or smooth.
- (11) Number and length of carinate discal intervals, if any.
- (12) Shape of scutellum.
- (13) Condition of prosternal carinae.
- (14) Condition of anterior portion of prosternum whether straight or lobed when viewed laterally.
- (15) Shape of prosternal process.
- (16) Extent and depth of mesosternal groove.
- (17) Disk of metasternum, whether flat or not and the extent and depth of the various impressions.
- (18) Secondary sexual characters.
- (19) Structure of the male genitalia. No case is known where these structures are the same for two or more species.

The following are the secondary sexual characters that have been observed in the species before me:

- (1) Male with a prominent and short longitudinal carina on middle of first abdominal sternite near base (*micros*).
- (2) Male with the inner apex of the front tibia with a short and prominent carina (*micros*).
- (3) Male with the inner apical fourth of the hind tibia moderately strongly excavated and distal margin of this concave portion with a small but prominent carina (*micros*).
- (4) Male with numerous erect, fine, long, and pale hairs on ventral surface of four basal segments of middle and hind tarsi (*micros*).
- (5) Male with the last segment of the hind tarsus strongly dilated and ventral surface of dilated part densely pubescent (*tarsalis*).

Xenelmis bufo (Sharp).

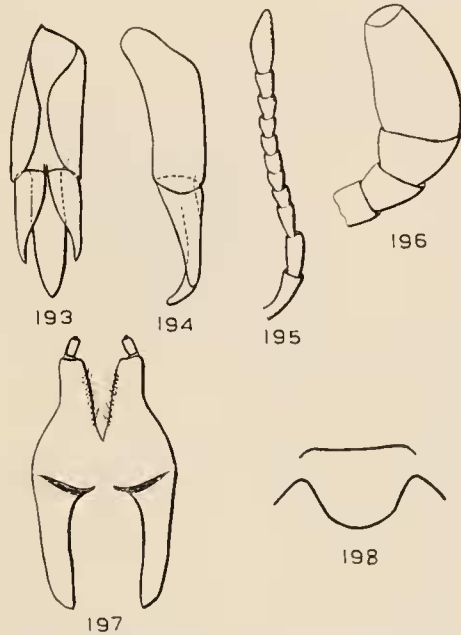
(Text-figs. 189-198.)

1882. *Elmis bufo* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 140.1936. *Xenelmis bufo* Hinton, *Ent. mon. Mag.*, 72 : 4, fig. 7.1936. *Xenelmis bufo* Hinton, *Trans. R. Ent. Soc. Lond.*, 85 (18) : 427, figs. 23, 24 ; pl. 1, fig. 3.

TEXT-FIGS. 189-192.—(189) Female reproductive system of *Xenelmis tarsalis* Hinton. (190) Adult of *Xenelmis bufo* (Sharp). (191) Alimentary canal of *Xenelmis tarsalis* Hinton. (192) Hind wing of *X. bufo* (Sharp). Venation after Forbes.

Male : Length, 1.42 mm.-1.62 mm. ; breadth, 0.87 mm.-0.95 mm. Cuticle feebly shining and rufo-piceous to black. *Head* on each side with a fine, low carina which extends from a point which is about a third of the way across between eyes, and is opposite posterior fourth of eyes, to posterior seventh of head ; these carinae converge posteriorly but do not meet so that at posterior end they are separated by a distance equal to half that of anterior end. Surface of head with

round, high granules which are about as coarse as facets of eyes or about 0.010 mm. broad and are usually separated by one to three times their diameters; each of these granules gives rise to a fine recumbent seta which is about twice as long as its respective granule; surface between granules densely and microscopically alutaceous. Clypeus with the fronto-clypeal suture straight and deep; anterior margin very feebly rounded to nearly truncate and with the angle on each side broadly rounded; surface sculptured as head. Labrum with the anterior margin truncate and with the angle on each side broadly rounded; surface on basal half smooth, on apical half with a narrow transverse belt of obscure, dense punctures, and on each side with a few very fine, testaceous hairs which are often about



TEXT-FIGS. 193-198.—*Xenelmis bufo* (Sharp). (193) Dorsal view of male genitalia. (194) Left lateral view of same. (195) Antenna. (196) Maxillary palp. (197) Female genitalia. (198) Prosternum.

0.05 mm. long. *Pronotum* across broadest point, which is at base, broader than long (0.72 mm. : 0.55 mm.) and base broader than apex (0.72 mm. : 0.35 mm.); evenly convex and surface with granules similar to those of head but usually separated by two to three times their diameters; area between granules much more sparsely alutaceous; at base in front of scutellum for a short distance (about a seventh of the length of the pronotum) there are no granules. *Elytra* slightly more than twice as long as pronotum (1.12 mm. : 0.55 mm.) and broadest point, which is across middle, broader than broadest point across humeri (0.90 mm. : 0.82 mm.). Lateral margins finely and regularly crenate, these crenations being due to laterally placed granules. Apices broadly conjointly produced and rounded. Surface with the striae as broad as strial punctures and very feebly impressed; discal strial punctures round to subquadrate, about a third to two-thirds as coarse as intervals, and separated longitudinally by one to one and a half times their diameters; these punctures become finer and denser towards

apex and coarser and denser towards sides. Intervals flat and with the surface sculptured as that of head except that here the granules are slightly coarser, especially towards sides. Granules of sublateral carina about a fourth to a third coarser than those elsewhere on elytra. *Scutellum* flat, subovate, broader than long (0.15 mm. : 0.10 mm.), base very broadly and feebly rounded, and narrowed to and acutely rounded at apex; surface sculptured as adjacent parts of elytra. *Prosternum* without distinct carinae; when viewed laterally the anterior half (not including process) is very feebly bent ventrally and the remainder of the prosternum and its process is on the same plane; process shaped as figured (text-fig. 198); surface of all of prosternum and hypomera sculptured as disk of elytra but with the granules slightly more distinct. *Mesosternum* with the groove for the reception of the prosternal process a third broader posteriorly than anteriorly and extending to posterior fifth of mesosternum; surface at sides sculptured as disk of elytra but without distinct granules. *Metasternum* with the median longitudinal line feebly impressed and extending to anterior fifth or sixth; disk nearly flat but along anterior margin moderately depressed at middle and more strongly so at sides; surface of disk with irregular to round, large (0.03 mm. broad), frequently confluent punctures and with only an occasional granule; between punctures and granules the surface is moderately densely microscopically alutaceous; sides of metasternum with the granules similar in size and distribution to those of sides of elytra but otherwise sculptured as metasternal disk except that the punctures are not as dense. Abdomen with the surface of sternites one to four sculptured as disk of elytra and the surface of five similarly sculptured but with the granules distinctly denser. *Genitalia* as figured (text-figs. 193, 194).

Female: Externally similar to male.

Type: In the British Museum (Nat. Hist.). PANAMA: Volcan de Chiriqui, alt. 2600–3000 ft. (*Champion*).

Specimens examined: 1, PANAMA: San Miguel, Pearl Island (*Champion*). 30, MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vi. 1933 (*H. E. Hinton, R. L. Usinger*); and 18, in the same locality in vii. 1934 (*H. E. Hinton*).

Variations: Except for the differences in absolute size as already noted, no variations worthy of mention have been observed.

Comparative notes: This species is apparently most closely related to the Brazilian *X. tarsalis* Hinton, but it may be distinguished from the latter by not having a row of close granules on the basal half of the third discal elytral interval.

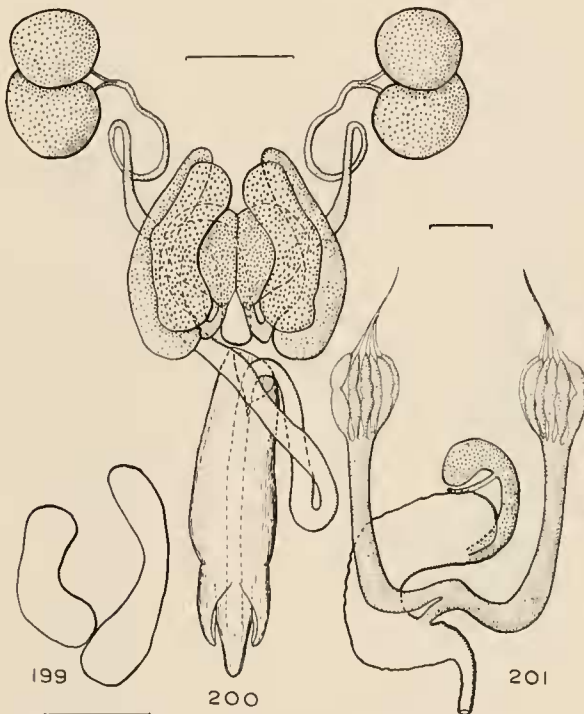
MICROCYLLOEPUS (Hinton).

1935. *Microcylloepus* Hinton, *Stylops*, 4 (8): 178.

In addition to the species referred to this genus by Hinton (1935), the following belong here: *M. thermarum* (Darlington) (*Elmis*) and *M. longipes* (Grouvelle) (*Elmis*). At the time of writing seven species and three varieties have been described. In my collection there are 13 new species, and of these three are from Mexico and will be described here. The species of this genus occur from Canada to the south of Brazil and have been taken in the British West Indies on Trinidad and Tobago. A redescription of the genus follows:

Body subparallel. Non-tomentose areas glabrous or clothed with sparse and short recumbent hairs. Scale-like or hairy tomentum confined to the following areas: (1) genae; (2) epipleura—many species have non-tomentose epipleura; (3) sides of prosternum, mesosternum, metasternum, and abdominal

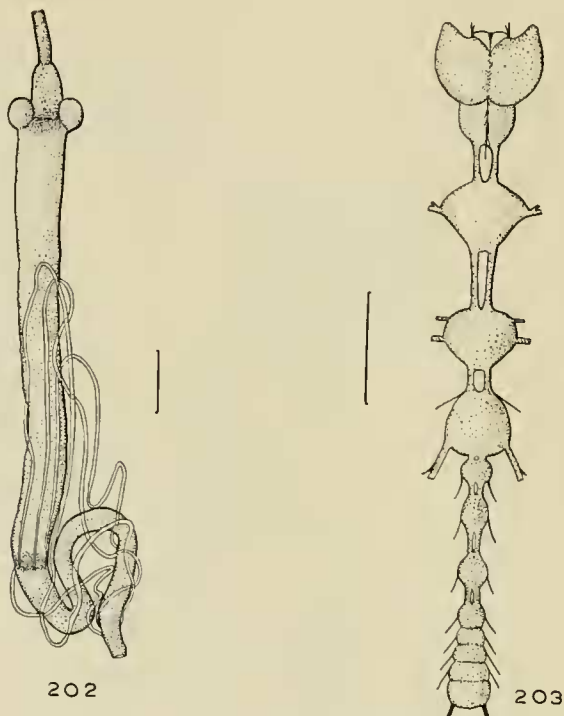
sternites, but in some species nearly the entire sternum of the abdomen is clothed with fine tomentum; and (4) part or all of legs except tarsi. *Head* when seen from below capable of being retracted so that none of the mouth-parts is visible. Antennae 11-segmented (text-fig. 218). Mandibles with three acute apical teeth; prostheca long and entirely membranous with numerous fine spines or hairs apically. Maxilla with the palp (text-fig. 219) 4-segmented and stipes with a well-developed palpifer; galea and lacinia separate and apex of each spinose or hairy. Labium with the palp 3-segmented and prementum with a poorly developed



TEXT-FIGS. 199-201.—*Microcylloepus carinatus* Hinton. (199) Lateral view of lateral accessory glands. (200) Male reproductive system. (201) Female reproductive system.

palpiger. Mentum as broad and three-fifths as long as submentum. Gula slightly longer than submentum, at anterior margin about two-thirds as broad as submentum, and with the sides feebly converging posteriorly. *Pronotum* with the anterior margin moderately arcuate at middle and on each side behind eye before apical angle broadly and moderately deeply sinuate. Base trisinate, broadly and moderately deeply so on each side and more narrowly and shallowly so in front of scutellum. Pronotum on each side with a sublateral carina which extends from base nearly to anterior margin; at apical two-fifths with a broad, moderately deep and complete or incomplete transverse impression which is always distinct at sides but in some species it is not evident on discal region; disk with or without a broad and deep median longitudinal impression; beginning either at base or at basal third on each side in front of scutellum is a

broad, deep or shallow impression which extends obliquely forwards, crosses sublateral carina at basal two-fifths, and joins apical transverse impression near lateral margin; sometimes this oblique impression is confined to sides; with or without a median longitudinal, feebly convex to carinate line extending from base in front of scutellum to posterior margin of longitudinal discal impression. *Elytra* punctate and striate; each elytron with a sublateral carina on eighth interval and one on sixth, though in a few species the carina of the sixth interval is absent or very indistinct. Hind wing without an anal lobe; without a radial cross vein



TEXT-FIGS. 202, 203.—*Microcylloepus carinatus* Hinton. (202) Alimentary canal.
(203) Dorsal view of central nervous system.

or an anal cell; first anal absent; second anal with the first branch present; second branch of second anal absent; third anal with the second branch absent; fourth anal well-developed; and cubito-anal cross vein present but incomplete and joining cubitus to second anal. *Prosternum* very long in front of anterior coxae; prosternal process long, narrow to moderately narrow, and with the posterior margin broadly rounded to nearly truncate. *Mesosternum* with a broad and deep groove for the reception of the prosternal process. *Metasternum* with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae rounded and trochantin completely concealed by the hypomera and sternum. Claws without teeth. *Alimentary canal* (text-fig. 202) with two caeca on the anterior margin of the mid-gut. Hind gut with six Malpighian tubules which end freely near the rectum. *Male reproductive system* (text-fig. 200) with the lateral accessory glands lobed. Each testis with two sperm tubes. Female

reproductive system (text-fig. 201) with six egg tubes to each ovary. Spermathecal duct opening into apex of bursa copulatrix. *Central nervous system* (text-fig. 203) with three thoracic discrete ganglia; first three abdominal ganglia discrete, and four to eight partly fused together, though the limits of each are distinguishable.

GENOTYPE: *Elmis pusilla* Leconte (1852).

The internal anatomy of three species has been examined and found to agree in essential details. That of *M. carinatus* Hinton is figured.

The species of *Microcylloepus* frequently bear a close resemblance to those of *Cylloepus* Erichson (*sensu stricto*), but may be distinguished as follows: (1) the pronotum has, at least at sides, a distinct apical transverse impression on apical two-fifths, whereas in *Cylloepus* no such impression is present; (2) the hind wing has the second branch of the third anal absent, whereas in *Cylloepus* it is present; (3) the alimentary canal has two instead of eight caeca on the anterior margin of the mid-gut; (4) each ovary has six instead of about 18 egg tubes; (5) the spermathecal duct opens into the apex of the bursa copulatrix instead of into the base; and (6) the central nervous system has the first three abdominal ganglia discrete, whereas in *Cylloepus* two to five are discrete.

A list of the characters which have been found useful in distinguishing the species is as follows:

- (1) General proportions, length and breadth.
- (2) Colour.
- (3) Size and distribution of the punctures and tubercles on the various sclerites and the density and type of microsculpture between them.
- (4) Condition of the fronto-clypeal suture.
- (5) Condition of anterior margin of clypeus, whether rounded, truncate, emarginate, or sinuate; and also the condition of the angle on each side.
- (6) Condition of the anterior margin of the labrum and the angle on each side.
- (7) Outline of pronotum and general proportions.
- (8) Extent and depth of the various pronotal impressions.
- (9) Shape of elytral apices.
- (10) Absence or presence of tomentum on epipleura.
- (11) Prominence and extent of the inner sublateral carina of the elytra.
- (12) If third discal interval is carinate at base the prominence and extent of the carina should be given.
- (13) Condition of other elytral intervals, whether flat, gibbous, or carinate.
- (14) Shape of scutellum and whether convex or flat.
- (15) Condition of anterior portion of prosternum, whether straight or bent ventrally when seen from the side.
- (16) Extent of prosternal carinae.
- (17) Shape of prosternal process.
- (18) Extent and depth of mesosternal groove.
- (19) Condition of disk of metasternum, whether flat or not, and the extent and depth of the various impressions.
- (20) Length, shape, and prominence of carina on each side of metasternal disk.
- (21) Length, shape, and prominence of carina on each side of middle of first abdominal sternite.
- (22) Secondary sexual characters.

- (23) Structure of the male genitalia. This is one of the very few genera in the family in which a number of species may have the structure of the male genitalia identical.

The following secondary sexual characters have been observed in the species before me :

- (1) Female with the sutural elytral interval strongly convex on apical third, while that of the male is only feebly convex (*carinatus*).
- (2) Female with the apex of each elytron produced to form an acute tooth, while in the male the apices are broadly and conjointly rounded (*carinatus*).
- (3) Male with the sides of the mesosternum between coxae densely clothed with fine testaceous hairs, while in the female this part is glabrous or very nearly so (*spinipes*).
- (4) Male with the disk of the metasternum more deeply and extensively concave than that of female (*carinatus*, *obesus*, *spinipes*).
- (5) Female with the metasternal disk more densely punctate than that of male (*obesus*).
- (6) Male with the carina on each side of metasternal disk more prominent than that of female (*obesus*).
- (7) Female with the region near the apex of the fifth abdominal sternite moderately gibbous (*carinatus*, *spinipes*).
- (8) Male with the outer edge of the front and middle tibiae gibbous on basal two-fifths (*plaumani*).
- (9) Male with an acute tooth concealed in a tuft of erect, testaceous hairs on inner apex of all tibiae (*carinatus*).
- (10) Male with the ventral apex of the basal segment of front tarsi strongly and acutely produced and at apex of produced portion with a long and acute spine (*spinipes*).
- (11) Male with the ventral mesal surface of the hind coxae with numerous recumbent, testaceous hairs which are here much sparser or absent in the female (*spinipes*).
- (12) Male with the inner apical spur of the hind tibiae very long, slender, and slightly curved forwards (*spinipes*).

A KEY TO THE MEXICAN SPECIES OF *Microcylloepus*.

1. Scutellum strongly convex. MEXICO *M. obesus*, sp. n.
Scutellum flat, rarely very feebly convex 2.
2. Humeri narrow, greatest breadth across humeri less or only very little more than greatest breadth across pronotum. Elytra with the punctures of the first and second striae on basal third broader than intervals. MEXICO *M. angustus*, sp. n.
Humeri broad, always distinctly broader than greatest breadth across pronotum. Elytra with the punctures of the first and second striae on basal third seldom as broad as intervals 3.
3. Small species with the mean length from apex of elytra to middle anterior margin of pronotum 1.772 mm. (altitude, 5600-7500 ft.). Elytra with the third discal interval strongly convex to carinate on basal fifth or sixth; inner sublateral carinae usually as prominent as outer. GUATEMALA, MEXICO *M. inaequalis* (Sharp) (1882).

Large species with the mean length from apex of elytra to middle anterior margin of pronotum 2.003 mm. (altitude, 5600-7500 ft.).

Elytra with the third discal interval at most only very feebly convex on basal seventh; inner sublateral carinae never as prominent as outer and frequently so flat that they are scarcely noticeable.

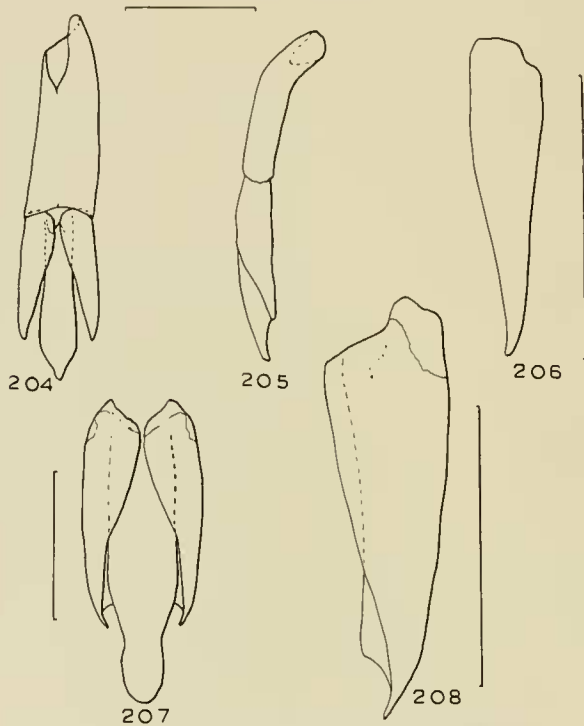
MEXICO *M. troilus*, sp. n.

***Microcylloepus obesus* sp. n.**

(Text-figs. 207-208.)

Male: Length, 2.215 mm.-2.415 mm.; breadth 1.00 mm.-1.10 mm. Cuticle shining and rufo-piceous to black; antennae, mouth-parts and legs paler rufo-piceous. *Head* without distinct impressions; surface with round granules which are about 0.017 mm. broad and are usually separated by one to three times their diameters; surface between granules with round to irregularly shaped microscopic punctures (about 0.001 mm. broad) which are confluent to separated by twice their diameters—under low magnifications ($\times 70$) the surface does not appear punctate but densely and microscopically alutaceous. Clypeus with the fronto-clypeal suture well impressed and nearly straight; anterior margin when seen from in front shallowly and arcuately emarginate for its entire breadth; angle on each side broadly rounded; surface sculptured as head. Labrum with the anterior margin feebly rounded and the angle on each side broadly rounded; surface without granules, basally and at sides with fine punctures similar in size and distribution to those of clypeus, apical half at middle with the punctures usually twice as large and half as dense and apical sides with numerous fine, testaceous hairs which are about 0.05 mm. long. *Pronotum* across broadest point, which is at basal third, as broad as long (0.70 mm.) and base broader than apex (0.63 mm. : 0.48 mm.). Sides deeply and broadly sinuate opposite apical transverse impression and very feebly sinuate to nearly straight before basal angles. Sublateral carina extending from base very nearly to apex. Impressions as figured for *inaequalis* (text-fig. 209) but without a longitudinal ridge from base to posterior margin of longitudinal discal impression. Disk of pronotum very densely, frequently confluent punctate with punctures which are from 0.006 mm. to 0.02 mm. broad except as follows: on the middle portion of the anterior third the punctures are usually separated by three to five times their diameters; and at sides near sublateral carinae on basal fourth the punctures are separated by one to three times their diameters. Sides between sublateral carinae and lateral margins sculptured as head. *Elytra* more than twice as long as pronotum (1.72 mm. : 0.70 mm.) and at broadest point, which is across apical third, broader than broadest point across humeri (1.07 mm. : 1.05 mm.). Epipleura without tomentum. Lateral margins moderately feebly and irregularly crenate. Apices broadly and strongly produced and conjointly feebly rounded. Surface with the striae moderately strongly impressed basally and feebly impressed on apical third; strial punctures on basal third of disk are round to feebly subquadrate, deep, about as broad as intervals and separated longitudinally by less than to once their diameters; from basal third to apex these punctures gradually become finer so that near apex they are half as coarse as at base, half to two-thirds as broad as intervals, and separated longitudinally by two to three times their diameters. Intervals flat except for third which is very feebly convex for a short distance behind level of scutellum; surface with an occasional microscopic puncture and sparsely transversely alutaceous but on base at sides and on basal

third between lateral margins and sublateral carinae with round granules similar to those of sides of pronotum, and which on gibbous portion of humeri are separated by about their diameters, while elsewhere they are sparser. Inner sublateral carinae less prominent than outer. *Scutellum* moderately strongly convex, subovate, longer than broad (0.12 mm. : 0.10 mm.), base feebly rounded, and apex more strongly and narrowly rounded; surface sculptured as adjacent elytral intervals. *Prosternum* when seen from the side with the anterior four-fifths (not including process) gradually to moderately sharply and moderately strongly



TEXT-FIGS. 204-208.—(204) Dorsal view of male genitalia of *Microcylloepus angustus* Hinton. (205) Right lateral view of same. (206) Left paramere of same species. (207) Dorsal view of male genitalia of *M. obesus* Hinton. (208) Left paramere of same.

bent ventrally; prosternal carinae prominent, present on basal fourth, feebly diverging anteriorly, and posteriorly as broad as process at base; process moderately narrow, with the sides converging to apex and with the apex broadly rounded; surface for the most part densely asperate. Hypomera with the surface densely asperate and with an occasional granule. Mesosternum with the anterior two-fifths of the groove for the reception of the prosternal process broad, deep, and smooth-bottomed; on posterior three-fifths it is deeper but only half as broad, extends nearly to metasternum, and the bottom is densely asperate; mesosternum between coxae moderately depressed and surface densely microscopically punctate to asperate. Metasternum with the median longitudinal line complete; disk with the posterior four-fifths very broadly and deeply depressed; surface with punctures about 0.017 mm. broad which are separated

by one to four times their diameters, and at posterior third on each side near discal carina with a broadly oval (0.07 mm.), moderately deep depression; discal carinae prominent, strongly diverging posteriorly, and extending to posterior fifth of metasternum. Abdomen with the carina of the first sternite prominent, feebly diverging posteriorly, and extending to posterior margin of the segment; middle area of first sternite between carinae only feebly depressed anteriorly; surface of middle of sternites one to four with punctures which are usually separated by once to twice their diameters; surface of sides of first four sternites and all of anterior half of fifth very densely and microscopically punctate; apical half of fifth similarly punctate but also with round granules about 0.015 mm. broad which are separated by less than to twice or more times their diameters. *Genitalia* as figured (text-figs. 207, 208).

Female: Externally similar to male except as follows: (1) the metasternal disk is not as deeply and only about three-fifths as broadly depressed; (2) the metasternal disk has the punctures much denser, being seldom separated by more than their diameters and frequently confluent; and (3) the metasternal discal carina are less prominent.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Rio Verde, alt. 8000 ft., 14. vi. 1934 (H. E. Hinton).

Paratypes: 3, with same data as type.

Variations: One of the two females before me has the metasternal discal impression nearly as broad and deep as that of male but confined to posterior half of disk, and the sides of disk near impression are feebly but distinctly convex, whereas those of the female mentioned above are flat.

Comparative notes: This is the largest known species of *Microcylloepus*. From all others it may be immediately distinguished by its moderately strongly convex instead of flat scutellum and by the structure of the male genitalia.

***Microcylloepus angustus*, sp. n.**

(Text-figs. 204-206.)

Male: Length, 1.42 mm.-1.67 mm.; breadth, 0.55 mm.-0.67 mm. Cuticle shining and rufo-piceous to black; antennae, mouth-parts, and legs paler rufo-piceous. *Head* without distinct impressions; surface, particularly at sides, with an occasional round granule which is about 0.012 mm. broad or slightly finer than an eye facet; surface everywhere densely microscopically alutaceous, this microsculpture sometimes appearing asperate. Clypeus with the fronto-clypeal suture deeply impressed and straight; anterior margin when seen from in front shallowly and arcuately emarginate for its entire breadth; angle on each side broadly rounded; surface sculptured similarly to head and at sides also with an occasional obscure granule. Labrum with the anterior margin feebly rounded and the angle on each side broadly rounded; surface without granules, only sparsely and very finely alutaceous, with numerous very fine (about 0.004 mm. broad) punctures, and at anterior sides with numerous fine, testaceous hairs which are about 0.05 mm. long. *Pronotum* across broadest point, which is at about basal half, broader than long (0.61 mm. : 0.57 mm.) and base broader than apex (0.50 mm. : 0.42 mm.). Sides moderately deeply and broadly sinuate opposite apical transverse impression and scarcely noticeably sinuate before basal angles. Sublateral carina extending from base very nearly to apex. The impressions are similar to those figured for *inaequalis* (text-fig. 209). Disk of pronotum very densely, frequently confluent, punctate with punctures which vary from 0.006

mm. to 0.012 mm., except as follows : on the middle portion of anterior third the punctures are often separated by as much as three times their diameters ; and on basal fourth on each side of median ridge the punctures are separated by once to twice their diameters. Sides between sublateral carinae and lateral margins as densely punctate as middle of disk and also with round, obscure granules which are as coarse as facets of eyes and are separated by one to three times their diameters. *Elytra* twice as long as pronotum (1.12 mm. : 0.57 mm.) and at broadest point, which is across apical two-fifths, broader than broadest point across humeri (0.675 mm. : 0.60 mm.). Epipleura without tomentum. Lateral margins regularly and moderately strongly crenate. Apices broadly, strongly produced and conjointly feebly rounded. Surface with the striae moderately impressed basally and more feebly impressed towards apex ; strial punctures on basal third of disk round to nearly subquadrate, moderately deep, usually about a third broader than intervals, and separated longitudinally by less than their diameters ; from about basal third to apex these punctures gradually become finer and sparser so that at apex they are two-thirds to half as coarse and dense as at base. Intervals flat except for third which is prominently carinate on basal sixth ; surface microscopically punctate and sparsely, transversely alutaceous but on base and on sides on basal third between lateral margins and inner sublateral carinae with round granules similar to those of sides of pronotum but somewhat sparser. Inner sublateral carina prominent and extending slightly beyond basal half. *Scutellum* at most very feebly convex, subovate, longer than broad (0.08 mm. : 0.06 mm.), base very feebly rounded, and apex more strongly and much more narrowly rounded ; surface sculptured like adjacent elytral intervals. *Prosternum* when seen from the side with the anterior half (not including process) gradually and moderately strongly bent ventrally ; prosternal carinae prominent, present on basal three-fifths, diverging anteriorly, and posteriorly slightly broader than process at base ; process moderately narrow with the sides nearly parallel and the apex broadly rounded ; lateral margins of process strongly gibbous ; surface as densely punctate as disk of pronotum, but on posterior sides and on process frequently asperate. Hypomera with the surface densely asperate and with occasional granules similar to those of sides of head. Mesosternum with the anterior two-fifths of the groove for the reception of the prosternal process broad, deep, and with the bottom smooth, while posterior three-fifths is deeper, only a third as broad, extends nearly to metasternum, and the bottom is asperate ; mesosternum between coxae moderately depressed and surface densely asperate. Metasternum with the median longitudinal line complete ; disk on anterior third moderately gibbous, but on posterior half broadly (0.07 mm.) and deeply depressed on middle and with a deep pit at posterior margin ; on posterior third on each side adjacent to discal carina is a broad (about 0.06 mm.), oval, moderately shallow depression ; surface on middle of disk (except for bottom of posterior depression which is microscopically asperate) with only an occasional microscopic puncture and sparsely transversely alutaceous, while the surface elsewhere is densely asperate as are sides of metasternum ; discal carinae prominent, feebly diverging posteriorly, and extending to posterior third. Abdomen with the carinae of the first sternite prominent, moderately diverging posteriorly, and extending to the posterior margin of the segment ; middle area of first sternite between carinae scarcely depressed anteriorly ; surface of middle of sternites one to four and extreme basal middle of fifth non-tomentose and with microscopic punctures which are usually separated by two to four times their diameters ; surface of sides of first four and most of fifth finely asperate when

the tomentum is rubbed off; apical third of fifth sternite with round granules about 0.010 mm. broad which are separated by once to twice their diameters. *Genitalia* as figured (text-figs. 204-206).

Female: Externally similar to male.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. 5600 ft., vii. 1934 (*H. E. Hinton*).

Paratypes: 16, with same data as type; and 1, also with same data but collected on 15.vii.1933 (*H. E. Hinton, R. L. Usinger*).

Variations: In some specimens the middle raised portions of the pronotal disk are not confluent punctate, the punctures here being separated by twice their diameters. A few have the surface of the ridge, which extends from base in front of scutellum to posterior margin of median longitudinal impression, with a few obscure granules. In many specimens the striae punctures on basal third of disk of elytra are occasionally longitudinally and laterally confluent. In some specimens the frontal region of the head as well as the sides has a number of round granules. In a few the middle portion of the metasternal disk has the microscopic punctures separated by once to twice their diameters, but they are here never dense enough to give the surface an asperate appearance.

Four specimens have been examined for the condition of the hind wings and all found to have them greatly reduced, the apex barely extending to a point opposite the posterior margin of the first abdominal sternite. As is the case with most beetles having the hind wings reduced, the humeri of this species are greatly narrowed.

Comparative notes: This species most nearly resembles *M. thermarum* (Darlington) of Oregon, but may be distinguished by having the inner sublateral carinae of the elytra moderately prominent and extending to apical half, whereas in *thermarum* the inner sublateral carinae are absent or scarcely visible. Of the Mexican species it can only be compared with *M. inaequalis* (Sharp), and from this may be distinguished by the structure of the male genitalia (*cf.* text-figs.), the narrow instead of broad humeri and the discal striae punctures on basal third of elytra which in *angustus* are generally broader than intervals, whereas in *inaequalis* they are seldom as broad as intervals. *M. angustus* is also a much shorter species (*vide* Table I).

The means of the lengths of these two species were found to be significantly different. Using the formula $t = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$, where M is the mean and S.E.M. is the standard error of the mean, $t = 10$. As may be seen from Fisher's (1936) table of t , the probability, P, of these two samples being got from the same populations is $P < .01$. Or using Fisher's table of x , which is in effect a continuation of t for numbers over 30, a better idea is got of the improbability of the two populations being homogeneous for length, as the probability here is $P < 10^{-9}$.

TABLE 1.

Species.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
<i>angustus</i> , 5600 ft.	1.4904	1.625	1.375	0.0740	0.0145	0.0214	13
<i>inaequalis</i> , 5600-7500 ft.	1.772	1.925	1.575	0.0782	0.0123	0.0170	20

Lengths are given in mm., and are taken from the apex of the elytra to the middle anterior margin of the pronotum. S.D. equals standard deviation; S.E.D. equals standard error of the deviation; and S.E.M. equals standard error of the mean.

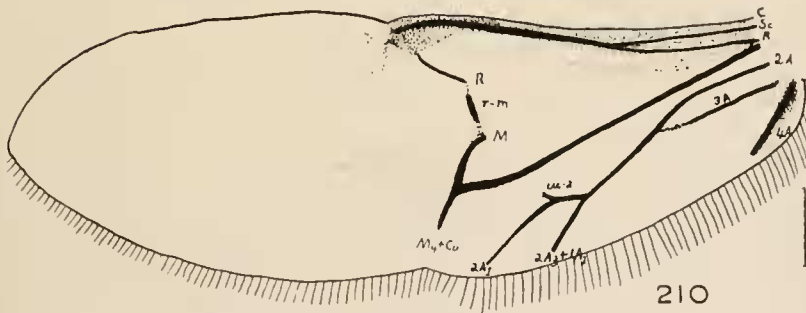
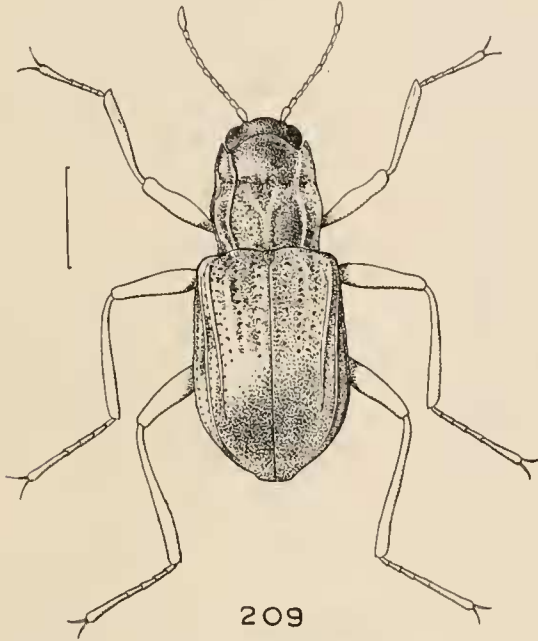
Microcylloepus inaequalis (Sharp).

(Figs. 209-213.)

1882. *Elmis inaequalis* Sharp, *Biol. Centr.-Amer. Col.*, **1** (2) : 137.
 1888. *Elmis inaequalis* Grouvelle, *Ann. Soc. Ent. Fr.*, **8** (6) : 408, t. 8, f. 11.
 1934. *Limnius mexicanus* Hinton, *Rev. Ent., Rio de J.*, **4** (2) : 199 (syn. n.).
 1935. *Microcylloepus inaequalis* Hinton, *Stylops*, **4** (8) : 179.
 1935. *Microcylloepus mexicanus* Hinton, *Stylops*, **4** (8) : 179.

Male : Length, 1.47 mm.-1.99 mm. ; breadth, 0.92 mm.-0.60 mm. Cuticle shining and rufo-piceous to black ; antennae, mouth-parts and legs usually paler rufo-piceous. *Head* without distinct impressions ; surface with an occasional round granule which is about 0.012 mm. broad or slightly coarser than a facet of an eye, these granules being more numerous at sides where they are separated by twice their diameters ; surface between granules densely, microscopically alutaceous, this microsculpture sometimes appearing asperate. Clypeus with the fronto-clypeal suture deeply impressed and straight ; anterior margin when seen from in front shallowly and arcuately emarginate for its entire breadth ; angle on each side broadly rounded ; surface sculptured similarly to head but even at middle with the granules separated by twice their diameters. Labrum with the anterior margin feebly rounded and the angle on each side broadly rounded ; surface moderately densely, microscopically alutaceous and also with a number of microscopic punctures, and at anterior sides with numerous fine, testaceous hairs which are about 0.075 mm. long. Pronotum across broadest point, which is at basal two-fifths, broader than long (0.60 mm. : 0.55 mm.) and base broader than apex (0.55 mm. : 0.42 mm.). Sides broadly and moderately deeply sinuate opposite apical transverse impression and scarcely noticeably sinuate before basal angles. Sublateral carina extending from base very nearly to apex. Impressions as figured (text-fig. 209). Disk of pronotum between sublateral carinae with an asperate type of alutaceous microsculpture like that of head on bottom of the impressions ; convex portions with microscopic (0.006 mm. broad) punctures which are usually separated by two to three times their diameters ; surface of median longitudinal ridge which extends from base to posterior margin of median impression very densely and microscopically punctate so that it nearly appears asperate. Sides between sublateral carinae and lateral margins sculptured as head but with the granules very slightly coarser and separated by one to four times their diameters. *Elytra* more than twice as long as pronotum (1.20 mm. : 0.55 mm.) and at broadest point, which is across apical third, broader than broadest point across humeri (0.82 mm. : 0.72 mm.). *Epi-pleura* without tomentum. Lateral margins regularly, moderately strongly crenate. Apices broadly, strongly produced and conjointly feebly rounded. Surface with the striae moderately impressed basally and more feebly impressed towards apex, so that on apical third of discal region the striae are practically absent ; strial punctures on basal third of disk round, deep, usually about one-half to two-thirds as broad as intervals, and separated longitudinally by one-half to one times their diameters ; from basal two-fifths to apex these punctures become finer and sparser so that near apex they are two-thirds as coarse and dense as those near base. Inner sublateral carinae prominent and extending to apical third of elytra. Intervals flat except for third which is strongly convex and diverging outwards on basal seventh ; surface of intervals microscopically punctate and sparsely, transversely alutaceous, but on base and on basal third at sides between lateral margins and inner sublateral carinae with round granules

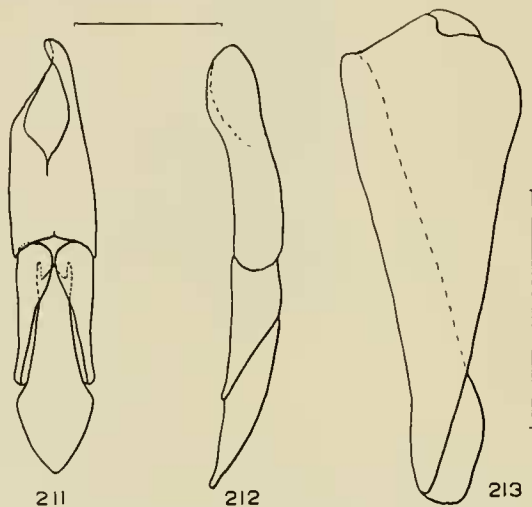
which are similar to those of sides of pronotum but are usually slightly sparser. *Scutellum* flat, subovate, longer than broad (0.10 mm. : 0.07 mm.), base very feebly rounded, and apex more strongly and much more narrowly rounded; surface sculptured as adjacent elytral intervals but with the granules slightly denser. *Prosternum* when seen from the side with the anterior three-fourths



TEXT-FIGS. 209, 210.—*Microcyloepus inaequalis* (Sharp). (209) Adult to show general appearance. (210) Hind wing. Venation after Forbes.

(not including process) gradually and moderately strongly flexed ventrally; prosternal carinae prominent, present on basal two-thirds, feebly diverging anteriorly, and posteriorly slightly broader than process at base; process moderately narrow and with the moderately strongly gibbous sides feebly converging to apex which is broadly rounded; surface for the most part sculptured similarly to that of head. Hypomera densely and distinctly asperate and with a few obscure granules similar in size to those of head. Mesosternum with the

groove for the reception of the prosternal process extending nearly to metasternum; with the anterior three-fifths of this groove broad, deep, and smooth bottomed, and with the posterior two-fifths only a third as broad, deep, and with the bottom densely asperate; most of the mesosternum between coxae depressed and with the surface densely asperate. Metasternum with the median longitudinal line complete; disk on anterior third moderately convex but on posterior two-thirds moderately deeply and broadly depressed, and with a deep narrow pit on posterior margin; disk on posterior third or half adjacent to discal carina on each side with a broad (about 0.075 mm.), oval, moderately deep depression; surface on middle of disk (except bottom of median longitudinal line which is densely alutaceous) sparsely, transversely alutaceous and also with a few microscopic punctures; surface of



TEXT-FIGS. 211-213.—*Microcylocepus inaequalis* (Sharp). (211) Dorsal view of male genitalia. (212) Left lateral view of same. (213) Left lateral view of paramere.

disk elsewhere densely asperate as well as non-tomentose parts of sides of metasternum; discal carinae moderately prominent and diverging outwards and extending to posterior third. Abdomen with the carinae of the first sternite prominent, feebly diverging posteriorly, and extending to posterior margin of the segment; middle area of first sternite between carinae scarcely depressed anteriorly; surface of middle of sternites one to four and extreme basal middle of fifth with punctures which are about 0.010 mm. broad and are usually separated by once to twice their diameters; surface of sides of first four and most of fifth tomentose but if the tomentum is rubbed off the surface is densely, microscopically alutaceous; apical third or fourth of fifth with round granules about 0.012 mm. broad which are separated by less than to once their diameters. *Genitalia* as figured (text-figs. 211-213).

Female: Externally similar to male.

Type: In the British Museum (Nat. Hist.). GUATEMALA: Guatemala City, alt. 5000 ft. (*G. C. Champion*).

Specimens examined: 23, with same data as type; and 10, GUATEMALA: San Joaquin (*G. C. Champion*). The following 2926 specimens were collected in MEXICO: 4, Atlisco (*Flohr, F. D. Godman*); 1, Vera Cruz (*Koebele*); 2071, Estado

de Morelos, Cuernavaca, alt. 4800 ft., vi. 1934 (*H. E. Hinton*); and 850, Dist. de Temascaltepec, Tejupilco to Real de Arriba, alt. 3500-7500 ft., v-vii. 1933 and 1934 (1933, *H. E. Hinton*, *R. L. Usinger*) (1934, *H. E. Hinton*).

Variations: This species is the most variable member of the genus that has been examined. The most striking variations are those concerning the sculpture of various sclerites, particularly the pronotum and the disk of the elytra. The convex parts of the pronotal disk are typically as described above, but in some specimens all of the disk except anterior third, which is densely punctate, is confluent punctate with punctures which are usually about 0.007 mm. broad, and the intermediates between this extreme and the normal are numerous. In some the striae punctures on basal third of disk of elytra are broader than intervals, being in these individuals relatively as broad as in *M. angustus*. In many the alutaceous microsculpture of the surface of the prosternal process is distinctly asperate. A few specimens have the entire middle of abdominal sternites two to five densely tomentose.

Samples selected at random were taken from localities at three different altitudes and measured for length. The length was taken from the apex of the elytra to the anterior margin of the pronotum, and the head was never included. Table II shows that there is an increase in size (the length of this species shows a high positive correlation with breadth) with an increase in altitude, and, as may be seen from Table III, the differences between the means of the three samples may be regarded as significant.

TABLE II.

	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
Temascaltepec, 5600-7500 ft.	1.772	1.925	1.575	0.0782	0.0123	0.0179	20
Cuernavaca, 4800 ft.	1.726	1.900	1.425	0.1100	0.0142	0.0204	30
Tejupilco, 3500-4000 ft.	1.620	1.850	1.400	0.1152	0.0135	0.0194	38

Lengths are given in mm. S.D. equals standard deviation; S.E.D. equals standard error of the deviation; and S.E.M. equals standard error of the mean.

TABLE III.

	t.	P.	x.	P.
Temascaltepec and Tejupilco	5.77	<.01	5.77	<10 ⁻⁸
Tejupilco and Cuernavaca	3.7	<.01	3.7	=10 ⁻⁴
Cuernavaca and Temascaltepec	1.71	<.10	1.71	<.08

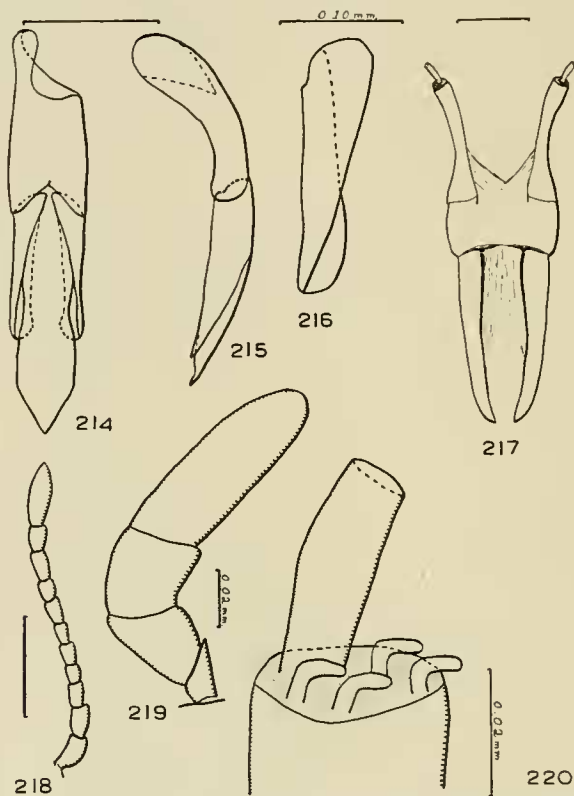
The significance of the difference between the means for length of the samples from the three different altitudes has been found by using the formula $t = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$, where M is the mean and S.E.M. the standard error of the mean. Since in all cases the sum of the samples is over 30, the probabilities have also been given for values of x (Fisher, 1936), as these probabilities of the homogeneity of the population are more accurate.

Comparative notes: Of those species already described, this can only be confused with *M. angustus*, but may be readily distinguished as has been pointed out above under the description of *angustus*.

Microcylloepus troilus sp. n.

(Text-figs. 214-220.)

Male: Length, 1.85 mm.-2.201 mm.; breadth, 0.82 mm.-0.97 mm. Externally similar to *inaequalis* except as follows: (1) the elytra has the third discal interval at most only very feebly convex on basal seventh, whereas in *inaequalis* it is strongly convex to carinate on basal fifth or sixth; (2) the inner sublateral carinae of the elytra are never as prominent as the outer and are frequently so



TEXT-FIGS. 214-220.—*Microcylloepus troilus* Hinton. (214) Dorsal view of male genitalia. (215) Left lateral view of same. (216) Lateral view of left paramere of same. (217) Female genitalia. (218) Antenna. (219) Maxillary palp. (220) Apex of left coxite of female genitalia.

feebly convex that they are scarcely visible, whereas in *inaequalis* they are always prominent and generally as prominent as outer carinae; (3) *troilus* is nearly always much larger and though there is some overlap the means for absolute length are very different (*vide* Table VI); and (4) the male genitalia are different (*cf.* text-figs. 214-216).

Female: Externally similar to male.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. about 7000 ft., vi. 1933 (*H. E. Hinton, R. L. Usinger*).

Paratypes: 163, collected in the same district from Temascaltepec to Real de Arriba, alt. 5600-7500 ft., v-vii. 1933 (*H. E. Hinton, R. L. Usinger*); 866, with

data as above but collected in 1934 (*H. E. Hinton*); and 260, in the same district at Rio Verde, alt. about 8000 ft., 14.vi.1934 (*H. E. Hinton*).

Variations: There is very little variation in the density of the punctures on the various sclerites. In no case are the inner sublateral carinae of the elytra as prominent as the outer, being one-half to two-thirds as high in 64 per cent., while in about 36 per cent. they are so feebly convex that they are scarcely noticeable. When viewed from the side the prosternum has the anterior three-fifths (not including process) bent ventrally in about half the cases, while in the other half the anterior three-fourths is bent. The prosternal carinae are usually present on basal half of prosternum, in a few cases they are on basal three-fifths or two-fifths, while in a very few they are confined to basal third. In a few cases the carinae of the first abdominal sternite extend only to posterior third of segment, but in the great majority they are complete or very nearly so.

A sample was selected at random from each of two altitudes. The specimens were measured for length from the apex of the elytra to the anterior middle margin of the pronotum. Table IV shows a slight increase in size with an increase in altitude. But, using the formula $t = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$, where M is the mean and S.E.M. the standard error of the mean, $t = 0.6$ and the probability of the two samples representing populations homogeneous for length is 50 per cent., so that the difference in size recorded in Table IV should be considered to be of no significance.

TABLE IV.

Altitude.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
8000 ft.	2.0130	2.150	1.850	0.0691	0.0073	0.0105	44
5600-7500 ft.	2.0034	2.125	1.825	0.0656	0.0070	0.0101	43

Lengths are given in mm. S.D. equals standard deviation; S.E.D. equals standard error of the deviation; and S.E.M. equals standard error of the mean.

Comparative notes: This species appears to be very close to *M. obesus*, but may be distinguished by such qualitative characters as the flat instead of convex scutellum and the differently formed male genitalia (*cf.* text-figs.). *M. troilus* is a distinctly smaller species as may be seen from Table V, being intermediate in size between *obesus* and *inaequalis*.

TABLE V.

Species.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
<i>obesus</i> , 8000 ft.	2.300	2.375	2.175	0.0866	0.0300	0.0500	4
<i>troilus</i> , 8000 ft.	2.0130	2.150	1.850	0.0691	0.0073	0.0105	44

Lengths are given in mm. and are taken from the apex of the elytra to the anterior middle margin of the pronotum. S.D. equals standard deviation; S.E.D. equals standard error of the deviation; and S.E.M. equals the standard error of the mean. The two means

were compared using the formula $x = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$, $x = 5.0$ so that $P < .10$ and the difference between the means may be regarded as being very significant.

TABLE VI.

Species.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
<i>troilus</i> , 5600-7500 ft.	2.0034	2.125	1.825	0.0656	0.0070	0.0101	43
<i>inaequalis</i> , 5600-7500 ft.	1.772	1.925	1.575	0.0782	0.0123	0.0179	20

Lengths are given in mm. and are taken from the apex of the elytra to the anterior middle margin of the pronotum. S.D. equals standard deviation; S.E.D. equals standard error of the deviation; and S.E.M. equals standard error of the mean. The two means were compared, using the formula $x = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$. $x = 11$ and $P < 10^{-9}$, so that the difference between these two means may be regarded as being very significant.

LARVAE.

The larvae of *Microcylloepus* have been determined by elimination and according to locality, e.g. this is the only genus of the family found in both California and Trinidad, B.W.I., and larvae have been collected by the writer in California which are difficult to separate from those taken in Trinidad. Four species of larvae are available, and from a study of these the following generic diagnosis has been made.

Generic Characters of Larvae of Microcylloepus.

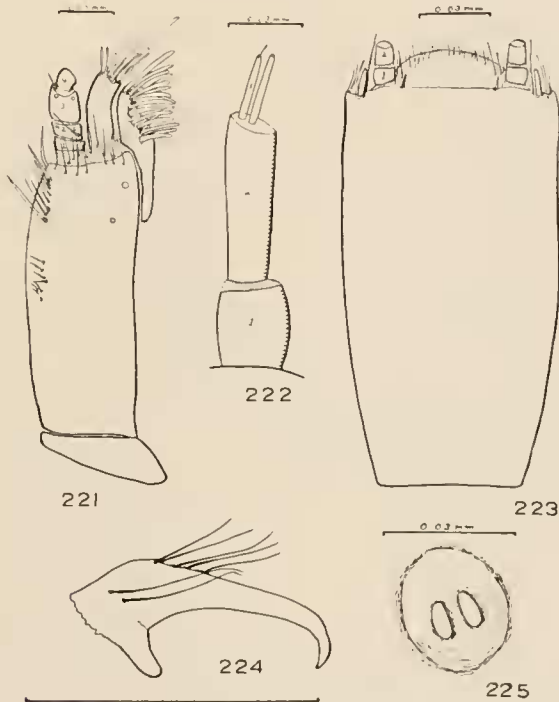
Body parallel, cylindrical, and evenly convex above. Tubercles of middle region of first eight abdominal tergites for the most part arranged in parallel, longitudinal rows. Head when viewed dorsally exposed and not at all concealed by the pronotum; anterior margin on each side between base of antenna and clypeus without a distinct tooth. With one ocellus on each side. Antennae (text-fig. 222) 3-segmented and not or only very feebly retractile. Clypeus not separated from the front of the head by a visible suture. Mandible (text-fig. 230) of both sides similar and with three obtuse apical teeth; prostheca long, slender, and densely spinose. Maxilla (text-fig. 221) with the palp 4-segmented and the stipes showing no differentiation into a palpifer; galea and lacinia separate and apex of each densely spinose. Labium (text-fig. 223) with the palp 2-segmented and prementum without a palpiger; post-mentum undivided. Hypopharynx with a sclerotized rod on each side. Gula not developed. Ventral sutures well-developed. *Prothoracic pleura* (text-fig. 226) divided into two parts and anterior part meeting on middle line of body so that sternum is here completely suppressed. Meso- and metapleura (text-fig. 226) divided into two parts. Abdominal segments one to seven with the pleura bounded by tergo- and sterno-pleural sutures and these two sutures converge on seventh segment and meet at its apex; segments one to seven with a pale dorsal line or suture parallel to tergo-pleural suture; segment eight forming a complete sclerotized ring; apex of ninth segment shallowly and broadly, arcuately emarginate. Operculum with two strongly sclerotized claws attached to its dorsal membrane. *Spiracles* present on mesothorax and first eight abdominal segments and opening at the apices of small tubercles. Tracheae without air sacs; with three tufts of retractile anal gills. *Alimentary canal* with an oesophageal sclerite on posterior dorsal margin of the oesophagus. Hind gut with six Malpighian tubules which end freely near the rectum. *Central nervous system* with three thoracic and eight abdominal discrete ganglia.

The larvae of this genus are very close to those of *Elsianus* and *Neoelmis*, but from the former may be distinguished by the absence of a fronto-clypeal suture and the absence of a tooth on anterior margin of head between the base of antenna and clypeus. From *Neoelmis* they may be distinguished by having six instead of four Malpighian tubules, and by having the tubercles on the dorsal surface arranged in rows.

Description of Mature Larva of M. inaequalis (Sharp).

(Text-figs. 221-231.)

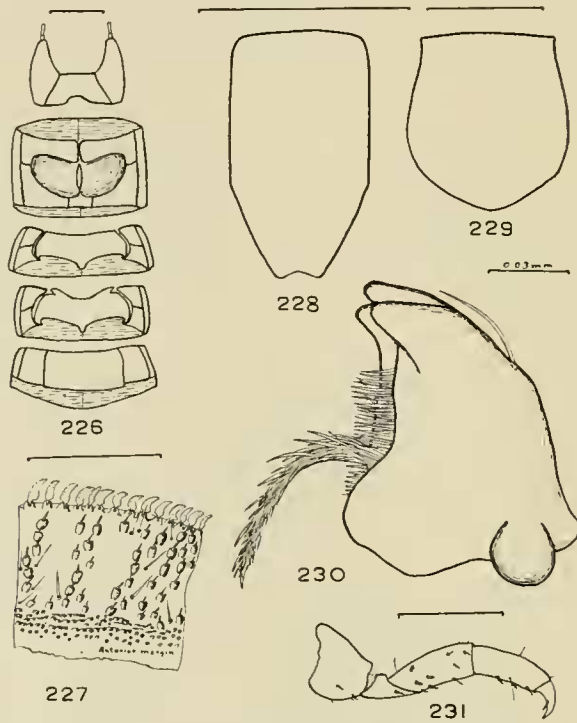
Length 4.0 mm.; breadth (across broadest point which is near base of metathorax), 0.55 mm. Elongate, subparallel, and cylindrical to subtriangular in



TEXT-FIGS. 221-225.—Larva of *Microcylloepus inaequalis* (Sharp). (221) Ventral view of right maxilla. (222) Dorsal view of left antenna. (223) Ventral view of labium. Setae of prementum are only approximately correct. (224) Dorsal view of right opercular claw. (225) Mesothoracic spiracle.

cross section. Cuticle moderately shining and moderately dark brown to brownish testaceous. *Head* at broadest point, which is at basal third, about as broad as long (0.30 mm.); posterior dorsal margin (text-fig. 226) broadly, deeply, and arcuately emarginate; epicranial suture 0.012 mm. long; frontal suture on each side extending in a nearly straight line to anterior margin of head near inner base of antenna; anterior margin between base of antenna and clypeus without a tooth; surface sparsely pubescent with fine and erect hairs which are usually about 0.03 mm. long; surface on a basal belt which extends as far as beginning of frontal sutures with round, microscopic (about 0.004 mm. broad) granules

which are usually separated by once their diameters; surface elsewhere with moderately convex, oval granules which are about 0.012 mm. broad and are usually separated by less than to one and a half times their diameters; anterior dorsal margin with a single row of these granules which are about a fourth coarser and slightly denser; all granules except fine ones of basal belt have a fine seta which is about three-fourths as long as its respective granule on apical anterior margin. *Terga* of thoracic and abdominal segments with the granules for the most part similar to those of head but usually as coarse as those of anterior row.



TEXT-FIGS. 226-231.—Larva of *Microcylloepus inaequalis* (Sharp). (226) Ventral view of thorax and first abdominal segment to show sclerotization. (227) A section of the fifth abdominal tergite to show arrangement of tubercles. (228) Dorsal view of ninth abdominal segment. (229) Operculum. (230) Mandible. (231) Inner face of front leg.

Pronotum with the granules of posterior half partly arranged in a series of irregular, parallel, longitudinal rows; all of tergites of last two thoracic and first eight abdominal segments with the granules arranged in similar rows (text-fig. 227); posterior margin of all segments except ninth and anterior margin of pronotum with a row of dense tubercles from which arise large, flat setae (text-fig. 227); anterior seventh or eighth of all segments except pronotum with a belt of fine (similar to those of basal belt of head), flat-topped, subquadrate to round tubercles; ninth tergite with a median longitudinal, strongly convex ridge extending from anterior eighth to posterior fifth and at middle about 0.07 mm. broad and 0.05 mm. high; apex of this segment (text-fig. 228) broadly and shallowly, arcuately emarginate. Sternites with the tubercles usually only two-thirds as coarse as

those of tergites, separated by two to three times their diameters, and not arranged in rows but otherwise similarly sculptured; sternites of last four abdominal segments with the tubercles coarser and usually separated by only twice their diameters; first abdominal sternite at middle anterior margin with a large (0.03 mm. broad) and high tubercle. Operculum (text-fig. 229) with the claws (text-fig. 224) not toothed. *Pleurites* tuberculate as their respective sternites except for those of prothorax which are about twice as densely tuberculate. *Legs* all fairly similar in chaetotaxy to front leg (text-fig. 231) and with the front pair shortest and the hind pair longest. *Spiracles* opening on apices of small tubercles and all similar to those of mesothorax (text-fig. 225).

Specimens examined: 22, MEXICO: Estado de Morelos, Cuernavaca, alt. 4800 ft., vi. 1934 (*H. E. Hinton*).

Among the series before me are a few specimens representing at least one earlier instar, but these apparently differ in no way but size from the mature larvae.

NEOELMIS Musgrave.

1935. *Neoelmis* Musgrave, *Proc. Ent. Soc. Wash.*, **37** (2) : 34.

1936. *Neoelmis* Hinton, *Ent. Mon. Mag.*, **72** : 5.

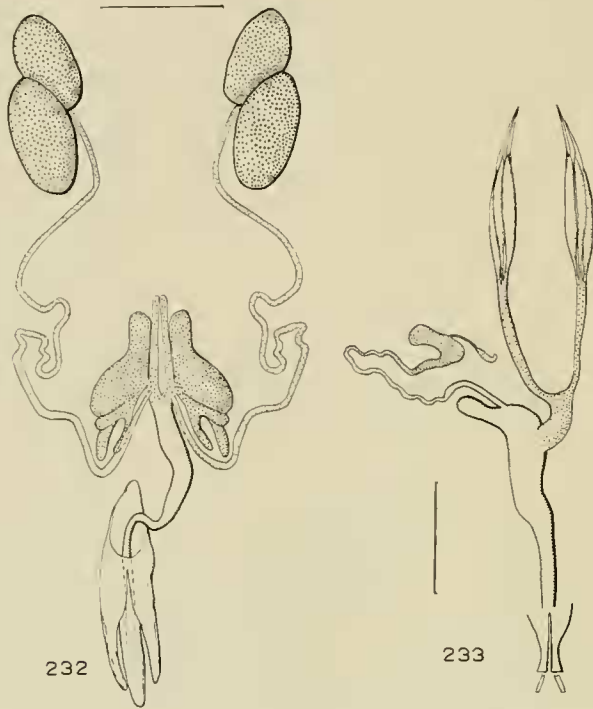
1936. *Elmis* Darlington, *Psyche*, **43** : 70.

This genus was erected by Musgrave to contain a new species from Puerto Rico, and to it he also referred *Elmis apicalis* Sharp, *E. caesa* Leconte, and *E. minima* Darlington. Hinton (1936) added a few generic characters omitted from the original description and referred *Elmis simoni* Grouvelle of Venezuela to the genus. Darlington (1936) sunk this genus as a synonym of *Elmis* Latreille, a genus very different from *Neoelmis* in the structure of the internal and external anatomy of both larvae and adults. If Darlington is correct and *Elmis* and *Neoelmis* should be united, then all the well-known genera of European Elmini, with the possible exception of *Stenelmis* Dufour, must be sunk as synonyms of *Elmis*, for between these and *Elmis* there is less difference than between *Elmis* and *Neoelmis*. Such a course would invalidate the work of Erichson, Ganglbauer, Reitter, etc., on the adults and the work of Bertrand on the larvae. Perhaps it is needless to add that Darlington's conception of the generic limits of *Elmis* is followed by none of the present authorities on the family.

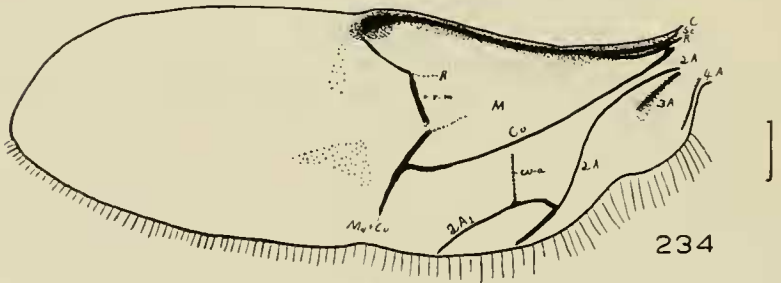
At the time of writing there are 21 species known. These occur from southern United States to south Brazil, and three species are known from the West Indies. A redescription of the genus follows:

Body subparallel and usually long and narrow. Non-tomentose areas glabrous or clothed with sparse and short recumbent hairs. Scale-like or hairy tomentum confined to the following areas: (1) genae; (2) epipleura; (3) sides of prosternum (in some species, e.g. *maculata*, there is no tomentum on the prosternum); (4) sides of mesosternum, metasternum and abdominal sternites, but in some species nearly the entire metasternum and the sternum of the abdomen is clothed with fine tomentum; and (5) part or all of legs except tarsi. *Head* when seen from below capable of being retracted so that none of the mouth-parts is visible. Antennae 11-segmented (text-fig. 246). Mandibles with three subacute, apical teeth; prostheca long and entirely membranous with numerous long spines or hairs apically. Maxilla with the palp (text-fig. 245) 4-segmented and stipes with a well-developed palpifer; galea and lacinia separate and apex of

each spinose or hairy. Labium with the palp 3-segmented and prementum without a distinct palpiger. Mentum about as broad and three-fourths as long as submentum. Gula slightly longer than submentum, at anterior margin about four-fifths as broad as submentum, and with the sides feebly converging, so that



TEXT-FIGS. 232, 233.—*Neelmis thoracica* (Grouvelle). (232) Male reproductive system. (233) Female reproductive system.



TEXT-FIG. 234.—Hind wing of *Neelmis longula* Hinton. Venation after Forbes.

at posterior margin it is only half as broad as submentum. *Pronotum* with the anterior margin moderately arcuate at middle and on each side behind eye before apical angle broadly and moderately deeply sinuate. Base trisinuate, broadly and moderately so on each side and more narrowly and shallowly so in front of scutellum. *Pronotum* on each side with a sublateral carina which extends from base nearly to anterior margin; at apical two-fifths with a deep, broad, and

complete transverse impression; disk on either side of transverse impression evenly convex, though occasionally with a gibbosity in front of the scutellum. *Elytra* punctate and striate; each elytron with a sublateral carina on sixth interval. Hind wing (text-fig. 234) with a very feebly developed anal lobe; without a radial cross vein or an anal cell; first anal usually absent; second anal with the second branch absent; third anal only present basally and not joined to second anal; fourth anal well developed; and cubito-anal cross vein joining cubitus to second anal, though often incomplete. *Prosternum* very long in front of anterior coxae; prosternal process long, narrow or broad, and posterior margin of process nearly truncate to broadly rounded. Mesosternum with a broad and deep groove for the reception of the prosternal process. Metasternum with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae rounded and trochantin completely concealed by the hypomera and sternum. Claws without teeth. *Alimentary canal* with three, two or no caeca on the anterior margin of the mid-gut. Hind gut with four Malpighian tubules which end freely near the rectum. *Male reproductive system* (text-fig. 232) with the lateral accessory glands lobed. Each testis with two sperm tubes. *Female reproductive system* (text-fig. 233) with four egg-tubes to each ovary. Spermathecal duct opening into middle of bursa copulatrix. *Central nervous system* with three thoracic discrete ganglia; abdominal ganglia one to six discrete; and seven and eight fused, but with the limits of each distinguishable.

GENOTYPE: *Neelmis gracilis* Musgrave (1935).

The internal anatomy of three species has been examined and found to agree in essential details, except that the number of caeca of the mid-gut varies. That of *N. thoracica* Grouvelle is figured.

This genus appears to be nearer to *Esolus* Mulsant and Rey than to any other described genus. From *Esolus* it may be distinguished as follows: (1) the hypomera are not clothed with tomentum as they are in *Esolus*; (2) the pronotum has a deep and complete transverse impression on apical two-fifths, whereas in *Esolus* it is more or less evenly convex; (3) the hind wing has the second anal branched and at least part of a cubito-anal cross vein is present, whereas in *Esolus* the second anal is not branched and there is no cubito-anal cross vein; (4) the anterior margin of the mid-gut has three, two, or no caeca, whereas in *Esolus* no caeca are here present; and (5) the central nervous system has only the seventh and eighth ganglia partly fused to form a terminal abdominal ganglion, whereas in *Esolus* the terminal abdominal ganglion consists of a fusion of ganglia four to eight.

A list of the specific characters which seem to be of most importance in distinguishing the species of *Neelmis* is as follows:

- (1) General proportions, length and breadth.
- (2) Colour. In some species, e.g. *maculata*, the elytra are maculate.
- (3) Size and distribution of the punctures on the various sclerites and the density and type of the microsculpture, if present, between the punctures.
- (4) Condition of fronto-clypeal suture.
- (5) Anterior margin of clypeus, whether rounded, truncate, emarginate, or sinuate; and also the condition of the angle on each side.
- (6) Condition of anterior margin of labrum and the angle on each side.
- (7) Outline of pronotum and its general proportions.
- (8) Condition of disk of pronotum, whether with gibbosities or evenly convex.

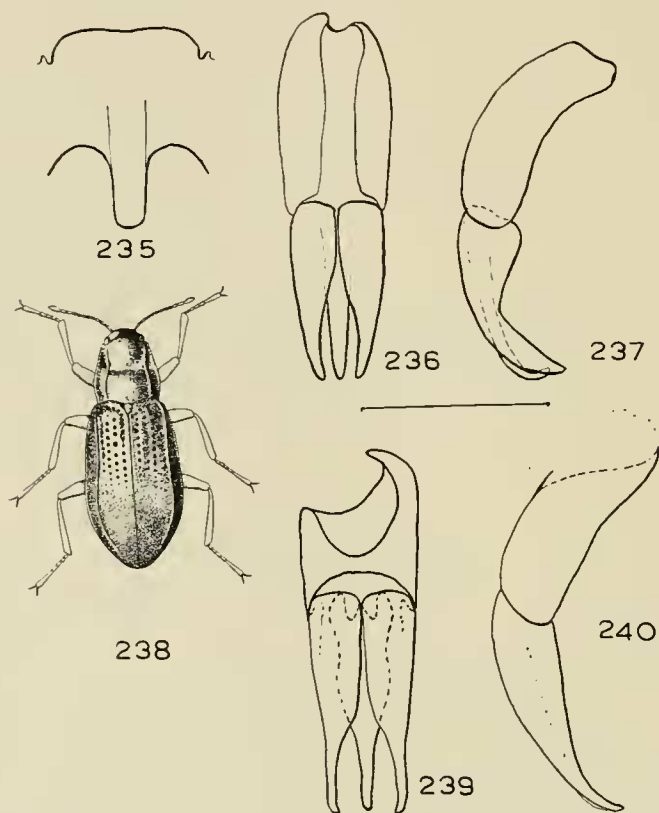
- (9) Shape of elytral apices.
- (10) Shape of scutellum.
- (11) Condition of anterior portion of prosternum, whether straight or bent ventrally when viewed from the side.
- (12) Extent of tomentum, if any, on sides of prosternum.
- (13) Condition of prosternal carinae. In some species they are absent, but when present may be parallel, diverging or converging anteriorly, or contiguous anteriorly. If they are parallel their breadth apart should be given.
- (14) Breadth of prosternal process.
- (15) Condition of sides of prosternal process. In some species they are strongly gibbous, while in others they are not at all thickened.
- (16) Extent and depth of mesosternal groove.
- (17) Disk of metasternum, whether flat or not and the extent and depth of the impressions.
- (18) Length, shape, and prominence of carinae, if present, on middle of first abdominal sternite.
- (19) Secondary sexual characters.
- (20) Structure of male genitalia. No case is known where these structures are the same for two or more species.

A list of the secondary sexual characters that have been observed in the species before me is as follows:

- (1) Male with a tooth on anterior margin of prosternum (*gigas*, *prosternalis*, *simoni*).
- (2) Male with the disk of the metasternum more strongly and extensively concave than that of the female (*gigas*, *lobata*, *musgravei*, *prosternalis*).
- (3) Each side of median impression of metasternal disk of male with numerous testaceous hairs, and also densely punctate, while in female this region is glabrous or nearly so and is also sparsely punctate (*musgravei*).
- (4) Male with carinae on the middle of the first abdominal sternite, while in the female they are absent (*prosternalis*).
- (5) Male with the carinae of the first abdominal sternite converging, while in the female they are straight (*gigas*).
- (6) Male with a tubercle on each side of middle of first abdominal sternite (*gigas*, *prosternalis*).
- (7) Male with the anterior middle of the second abdominal segment feebly depressed (*aspera*, *azteca*, *longula*).
- (8) Male with the inner apex of the front tibia gibbous (*gigas*).
- (9) Male with a row of short and stout spines on inner apex of middle tibiae (*gigas*, *prosternalis*).
- (10) Male with a row of short and stout spines on inner ventral side of apical three-fourths of middle and hind tibiae (*apicalis*, *aspera*).
- (11) Male with a row of small spines on ventral side of apical segment of middle and hind tarsi (*gigas*, *lobata*, *prosternalis*).

In the following key for the separation of the Mexican species *N. caesa* Leconte is included. This species is to-day recorded only from Texas, but will very likely be found to occur in the north-western parts of Mexico which are a continuation of the same Sonoran faunal region.

carina and lateral margin is irregularly alutaceous to asperate; and the outer dorsal side of the basal three-fifths of sublateral carina is also microscopically alutaceous. *Elytra* nearly twice as long as pronotum (1.47 mm. : 0.58 mm.) and at broadest point, which is across apical third, broader than broadest point across humeri (0.82 mm. : 0.76 mm.). Lateral margins nearly smooth (under magnification of more than $\times 150$ they appear very finely and irregularly crenate). Apices moderately strongly, broadly produced and conjointly feebly rounded.



TEXT-FIGS. 235-240.—(235) Prosternum of *Neelmis longula* Hinton. (236) Dorsal view of male genitalia of same species. (237) Right lateral view of same. (238) Adult to show general appearance. (239) Dorsal view of male genitalia of *N. azteca* Hinton. (240) Right lateral view of same.

Surface with the striae feebly impressed on basal two-thirds, but absent on apical third; discal striae punctures deep, round to subquadrate, two-thirds to slightly broader than intervals, and separated longitudinally by a half to two thirds of their diameters; from apical half to apical third these punctures become rapidly finer so that at apical third they are about a third as coarse, only half as broad as intervals, and are separated longitudinally by twice their diameters; from apical third to apex they become slightly finer and sparser. Intervals flat; surface of intervals feebly, sparsely, very finely alutaceous and more finely punctate than pronotal disk; surface of intervals at extreme base and on basal fourth between lateral margins and sublateral carinae with round, low granules which are about

0.012 mm. broad and are usually separated by once to twice their diameters. *Scutellum* flat, subovate, longer than broad (0.10 mm. : 0.075 mm.), base feebly rounded, and apex more strongly rounded ; surface sculptured as sutural interval. *Prosternum* when seen from the side with the anterior three-fifths (not including process) moderately strongly but not sharply bent ventrally ; prosternal carinae present on posterior two-fifths, prominent, parallel, and separated by a distance equal to about four-fifths of the breadth of the process between coxae ; between carina and sterno-notal suture there is no distinct ridge ; process (text-fig. 235) moderately narrow, parallel, with the margins moderately strongly gibbous, and the posterior margin broadly rounded ; fine hairy tomentum present on most of sides ; surface sculptured similarly to discal elytral intervals but antero-lateral sides with a dense and asperate type of alutaceous microsculpture. Hypomera smooth and highly polished except for basal fifth, apical sixth, margins near sterno-notal suture, and bottom of depressions where it is mostly densely asperate. Mesosternum with the anterior portion of the groove for the reception of the prosternal process broad and deep, but at posterior half suddenly becoming twice as broad and slightly deeper so that all of the mesosternum between coxae except lateral and posterior margins is depressed. Metasternum with the median longitudinal line complete ; disk deeply and broadly depressed on middle posterior three-fifths and the bottom of the depression is asperate ; surface of disk elsewhere with irregularly-shaped punctures which are about 0.007 mm. broad and are separated by three to eight times their diameters, while the surface between the punctures is smooth ; sides of metasternum densely, microscopically alutaceous and this sculpture is sometimes asperate. Abdomen with the carinae of the first sternite straight except posteriorly where they are feebly curved inwards, and extending to posterior fifth of sternite ; the entire middle area of the first sternite between carinae is strongly depressed ; second abdominal sternite feebly depressed on middle of anterior third ; surface of basal half of middle of first sternite asperate, while apical half, middle region of sternites two to four, and basal third of fifth punctate similarly to metasternal disk ; apical two-thirds of fifth, as well as lateral part, with punctures which are about 0.012 mm. broad and are separated by two to three times their diameters ; sides of sternites one to four moderately densely, microscopically alutaceous. *Genitalia* as figured (text-figs. 236, 237).

Female : Externally similar to male except that middle third of the second abdominal sternite is not depressed.

Type : ♂ in the British Museum (Nat. Hist.). MEXICO : Dist. de Temascaltepec, Real de Arriba, alt. 6000-7000 ft., vii. 1933 (*H. E. Hinton, R. L. Usinger*).

Specimens examined : 10, with data as above but collected in v-vii ; 102, as above but collected in v-vii. 1934 (*H. E. Hinton*) ; and 7, in the same district at Rio Verde, alt. about 8000 ft., 14. vi. 1934 (*H. E. Hinton*). 13, MEXICO : Estado de Morelos, Cuernavaca, alt. about 4800 ft., vi. 1934 (*H. E. Hinton*).

Teratology : One female from Real de Arriba has a deep oval pit on the right-hand side of the metasternal disk.

Variations : In some specimens the carinae of the first abdominal sternite only extend to posterior half. There is an increase in size with an increase in altitude. This could not be tested on the material collected in the district of Temascaltepec, as sufficiently accurate altitude data are not available. But the series collected at Cuernavaca, which is at a lower altitude approximately within the same latitude, has a smaller mean value for absolute length (Table VII, text-fig. 241). The significance of the difference between the means of the series

collected in Cuernavaca and that collected in the district of Temascaltepec was calculated from the formula $t = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$, where M is the mean and S.E.M. is the standard error of the mean. In this case $t = 5.5$ and, as may be seen from Fisher's (1936) table of t , the probability, P , of these two series being got from the same population is considerably less than $P < .01$. This difference in absolute size of populations of the same species at different altitudes is probably due to a difference in temperature during the larval life of the species.

From the district of Temascaltepec there are 13 specimens collected between 5600 and 7500 ft. These are so similar to *longula* that I have been unable to separate them on any qualitative character. But, as may be seen from Table VII or text-fig. 241, the absolute length of the longest is not even close to the absolute length of the smallest of typical *longula*; and they may be readily separated on size even by the unaided eye. This series of small individuals (hereafter called X) may be *longula* or another species.

TABLE VII.

Altitude.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
5600-8000 ft.	2.0049	2.125	1.900	0.0607	0.0063	0.0090	46
4800 ft.	1.892	2.025	1.750	0.069	0.0136	0.0201	13
5600-7500 ft.	1.675	1.775	1.600	0.0445	0.0087	0.0127	13

The figures are given in mm. The lengths are taken from the apex of the elytra to the middle anterior margin of the pronotum, and the head was not included as to do so would have introduced a considerable error into the measurements, since the total length would vary in the order of 0.025 mm. : 0.100 mm. depending on how much the head happened to be retracted into the prothorax. S.D. equals standard deviation; S.E.D. equals standard error of the deviation; and S.E.M. equals standard error of the mean.

If X is *longula* it is obvious that some factor is playing the part of a sieve and sharply dividing the population into two size groups. This factor is not sex, as males and females occur in the proportion of about 1 : 1 in both groups. The population of *longula* may be infected by some protozoal or other disease the presence of which would make the size of any individual much larger or smaller. But even in this case lightly infected individuals intermediate in size would be expected to occur.

It seems much more probable that X is, in point of fact, a new species. If this is so, it should not be very surprising that these two species cannot be separated when the crudity of the available qualitative taxonomic methods is taken into account. X may differ from *longula* not only in one but in a great many genes which control the histological and biochemical structure of many different tissues. By the usual taxonomic methods applicable to dried specimens two or more related species can only be distinguished if there happens to be a difference in external characters. Even if the internal characters are alike, there may still be many biochemical differences of specific importance.

Comparative notes: *N. longula* may be distinguished from all its North American congeners by the smooth instead of asperate middle region of the hypomera and by the structure of the male genitalia.

***Neelmis azteca*, sp. n.**

(Text-figs. 239, 240.)

Male: Length, 1.92 mm.; breadth, 0.75 mm. Similar to *longula* except as follows: (1) the round granules at the base and sides of elytra are much less numerous and distinct; (2) the prosternal carinae distinctly converge so that anteriorly they are only half as far apart as at base; (3) the asperate type of alutaceous microsculpture completely covers the hypomera, and there are no smooth and polished areas; (4) the asperate microsculpture of the depressed portion of the middle of the first abdominal sternite extends over the basal two-thirds, whereas in *longula* it is confined to the basal half; and (5) the male genitalia are different (text-figs. 239, 240).

Female: Unknown.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. about 7000 ft., vii. 1934 (*H. E. Hinton*).

Paratype: A male with the same data as above.

***Neelmis apicalis* (Sharp).**

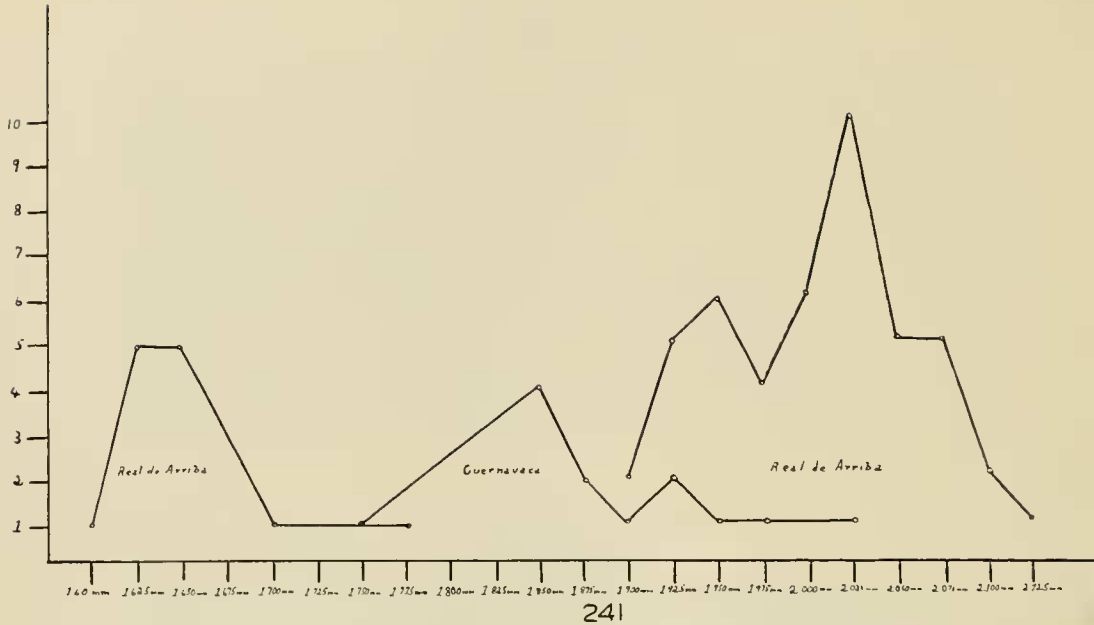
(Text-figs. 242-245.)

1882. *Elmis apicalis* Sharp, *Biol. Centr.-Amer. Col.*, **1** (2): 136, t. 4, fig. 14.

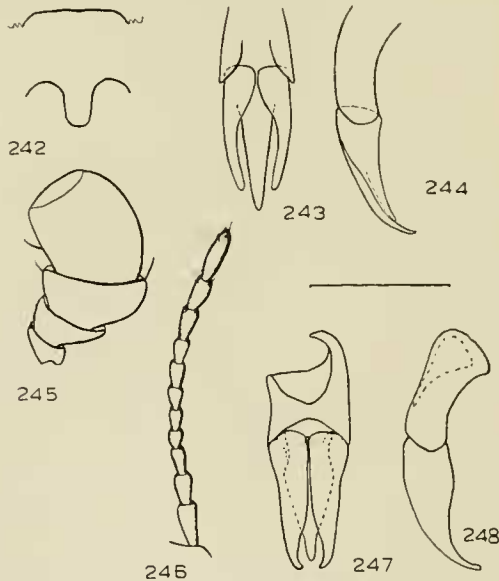
1935. *Neelmis apicalis* Musgrave, *Proc. Ent. Soc. Wash.*, **37** (2): 34, 35.

1936. *Neelmis apicalis* Hinton, *Trans. R. Ent. Soc. Lond.*, **85** (18): 426, fig. 22.

Male: Length, 1.57 mm.-1.75 mm.; breadth, 0.62 mm.-0.65 mm. Cuticle shining and rufo-piceous; antennae, mouth-parts, and legs paler rufo-piceous. *Head* without distinct impressions; surface very densely and microscopically, asperately alutaceous. Clypeus with the fronto-clypeal suture nearly straight and moderately feebly impressed; anterior margin when seen from in front truncate to very feebly rounded; anterior angles broadly rounded; surface at sides sculptured as head but elsewhere only occasionally alutaceous and with microscopic punctures (about 0.003 mm. broad) which are usually separated by two to five times their diameters. Labrum with the anterior margin feebly and broadly rounded and the angle on each side broadly rounded; surface punctate as middle region of clypeus but with the punctures denser and very slightly coarser. *Pronotum* across broadest point, which is at basal third, slightly broader than long (0.48 mm. : 0.46 mm.) and base broader than apex (0.42 mm. : 0.33 mm.). Sublateral carinae extending from base to very nearly apical margin. Impressions as in *longula*. Lateral margins feebly and regularly crenate. Surface on convex portions between sublateral carinae with fine (about 0.009 mm. broad) punctures which are usually separated by three to five times their diameters, and the surface between these punctures is smooth; elsewhere similarly sculptured except as follows: bottom of transverse impression with a very short belt (about a third as long as that of *longula*) of a dense asperate type of microsculpture; area between sublateral carinae with the basal fifth, anterior fifth, all of apical impression, and outer sides of sublateral carinae densely asperate. *Elytra* more than twice as long as pronotum (1.12 mm. : 0.46 mm.) and at broadest point, which is across apical third, broader than broadest point across humeri (0.62 mm. : 0.57 mm.). Lateral margins nearly smooth. Apices moderately strongly, broadly produced and conjointly feebly rounded. Surface with the striae feebly impressed on basal two-thirds but absent on apical third; discal strial punctures deep, usually round, as



TEXT-FIG. 241.—Frequency polygons of three populations of *N. longula* Hinton. The polygons are not adjusted to equal areas. The measurements are from the apex of the elytra to the anterior margin of the pronotum.



TEXT-FIGS. 242-248.—(242) Prosternum of *Neelmis apicalis* (Sharp). (243) Dorsal view of male genitalia. (244) Right lateral view of same. (245) Maxillary palp. (246) Antenna. (247) Dorsal view of male genitalia of *N. aspera* Hinton. (248) Right lateral view of same.

broad to half again as broad as intervals, and separated longitudinally by two-thirds to once their diameters; at apical two-fifths the discal punctures become only about a third as coarse and dense and from here to apex they gradually become finer so that at apex they are no more than a fourth as coarse and dense as those near base. Intervals flat, feebly, sparsely, microscopically alutaceous and also with punctures which are similar to those of pronotal disk but are more irregularly distributed; surface of intervals at extreme base with an occasional round, low granule which is about 0.012 mm. broad, and sides on basal fourth between lateral margins and sublateral carinae with similar granules which are frequently separated by no more than their diameters. *Scutellum* flat, subovate, slightly longer than broad (0.075 mm. : 0.070 mm.), base feebly, broadly rounded, and apex more strongly rounded. *Prosternum* when seen from the side with the anterior three-fifths (not including process) moderately strongly and sharply bent ventrally; prosternal carinae present on posterior two-fifths, prominent, parallel, and separated by a distance nearly equal to that of the process at base; on each side between carina and sterno-notal suture there is a prominent, thick ridge about 0.10 mm. long; process as figured (text-fig. 242) and with the lateral and apical margins moderately strongly gibbous; surface of prosternum and hypomera throughout densely asperate except for middle in front of process which is sculptured as disk of elytra. Mesosternum with the groove for the reception of the prosternal process broad and deep on anterior two-fifths, where the bottom of the groove is smooth, and suddenly becoming broader so that posterior three-fifths is nearly twice as broad and has the bottom densely asperate and at middle of this area there is a large (about 0.050 mm. long) oval, smooth-bottomed, deep pit; surface of sides of mesosternum asperate. Metasternum with the median longitudinal line complete, on basal five-sixths 0.50 mm. broad and deep, and on anterior sixth very narrow and feebly impressed; disk on each side on basal third with an irregularly round pit which is about 0.06 mm. broad; surface of disk and bottom of all impressions densely asperate except for a narrow smooth belt along sides of median line; sides of metasternum densely and obscurely asperately alutaceous. *Abdomen* with the carinae of the first sternite straight, prominent, and extending to posterior half of segment; middle of first sternite deeply depressed on anterior three-fourths; surface of sternites sculptured as follows: basal two-fifths of depressed portion of first sternite densely asperate; posterior three-fifths of middle of first sternite and all of middle of sternites two to four only sparsely microscopically alutaceous; and sides of first four sternites and all of fifth sculptured as sides of metasternum. *Legs* with the inner ventral side of apical four-fifths of middle and hind tibiae with a row of short and stout spines. *Genitalia* as figured, (text-figs. 243, 244).

Female: Externally similar to male except as follows: the middle and hind tibiae have no inner rows of short and stout spines.

Type: In the British Museum (Nat. Hist.). GUATEMALA: Vera Paz, San Joaquin (*Champion*).

Specimens examined: 1, with same data as type; and 2, in the same state at Rio Naranjo, 450 ft. (*Champion*). 200, MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vi. 1933 (*H. E. Hinton, R. L. Usinger*); 69, with data as preceding but collected in vii. 1934 (*H. E. Hinton*); 2, MEXICO: Estado de Morelos, Cuernavaca, alt. about 4800 ft., vi. 1934 (*H. E. Hinton*).

Variations: Apart from the variation in absolute size already recorded, none worthy of mention have been observed.

Comparative notes: From *N. longula* this species may be distinguished by

its entirely instead of only partly asperate hypomera, from *azteca* by the presence of a pit on each side of the metasternal disk, and from *caesa* by having the prosternal carinae parallel instead of converging anteriorly.

***Neoelmis aspera*, sp. n.**

(Figs. 247, 248.)

Male: Length, 1.70 mm.; breadth, 0.65 mm. Externally similar to *apicalis* except as follows: (1) the fronto-clypeal suture is not distinctly visible; (2) the belt of asperate microsculpture on the bottom of the apical impression of the pronotal disk is broader (about as broad as in *longula*); (3) the extreme base of the pronotum is asperate as is apical part of disk; (4) the prosternal carinae are indistinct and converge in front so that anteriorly they are separated by a distance equal to only half of breadth of process at base; (5) prosternum without a distinct ridge on each side between carina and sterno-notal suture; (6) nearly the entire non-impressed part of the metasternal disk is smooth; (7) the second abdominal sternite is feebly depressed on middle anterior third; and (8) the male genitalia are different (text-figs. 247, 248).

Female: Externally similar to male except as follows: the middle and hind tibiae have no short and stout teeth, and the basal third of middle of second abdominal sternite is not depressed.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Estado de Morelos, Cuernavaca, alt. 4800 ft., vi. 1934 (*H. E. Hinton*).

Paratypes: 8, with data as above; and 1, MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. about 7000 ft., vii. 1934 (*H. E. Hinton*).

Teratology: One male specimen from Cuernavaca has no pit on the left-hand side of the metasternal disk, and the pit on the right-hand side is relatively only three-fourths as long as is normal for this species.

Variations: In some specimens the carinae of the first abdominal sternite extend to posterior fifth of segment, while in others it only extends to posterior half, as is usual in *apicalis*.

Comparative notes: *N. aspera* is also very close to *caesa*, but differs in having the prosternal carinae anteriorly separated by a distance equal to about half the breadth of the process at base, whereas in *caesa* they are here separated by a distance equal to only a third the breadth of the process at base; and in having the flat parts of the metasternal disk mostly smooth, whereas in *caesa* the disk is here mostly asperate.

LARVAE.

No larvae of this genus were collected in Mexico. By elimination and according to locality the larvae of two Bolivian species of *Neoelmis* have been determined, and the following generic diagnosis is drawn up from a study of these.

Generic Characters of Larvae of Neoelmis.

Body subparallel and cylindrical to subtriangular in cross section; dorsal surface evenly convex. *Head* when seen from above exposed and not concealed by the pronotum; anterior margin on each side between base of antenna and clypeus with a short, indistinct, blunt tooth. Clypeus with the suture distinct. With one ocellus on each side. Antennae 3-segmented and not or only very feebly retractile. Mandibles of both sides similar and with three obtuse, apical

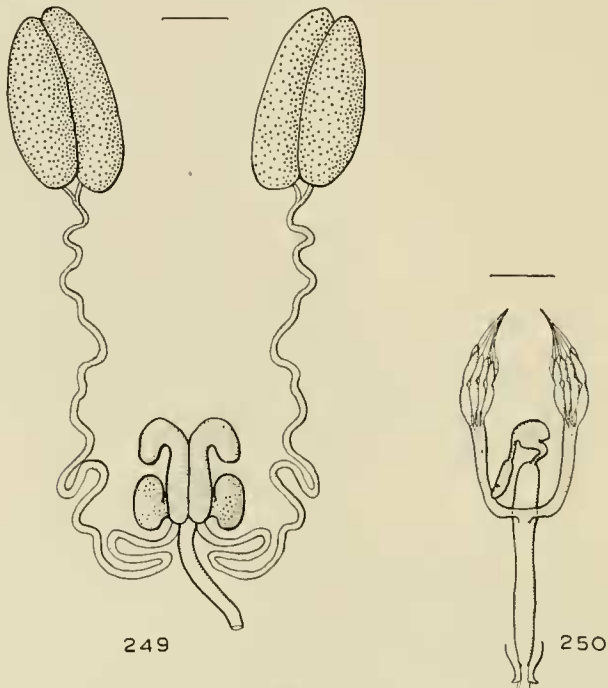
teeth; prostheca long, slender, and densely spinose. Maxilla with the palp 4-segmented and stipes showing no differentiation into a palpifer; galea and lacinia separate and apex of each densely spinose. Labium with the postmentum undivided; labial palp 2-segmented and prementum without a distinct palpiger. Gula well developed. *Prothoracic pleura* divided into two parts and anterior part meeting on middle line of body so that sternum is here completely suppressed. Meso- and metapleura each divided into two parts. Abdominal segments one to seven with pleura bounded by tergo- and sterno-pleural sutures and these two sutures converging and meeting at apex of seventh segment; segment eight forming a complete sclerotized ring. Operculum with two strongly sclerotized claws attached to its dorsal membrane. Apex of ninth segment broadly and arcuately emarginate. *Spiracles* present on mesothorax and first eight abdominal segments and opening at apices of small tubercles; trachea without air sacs; with three tufts of anal, retractile, tracheal gills. *Alimentary canal* with an oesophageal sclerite on the dorsal posterior margin of the oesophagus. Hind gut with four Malpighian tubules which end freely near the rectum. *Central nervous system* with three thoracic and eight abdominal discrete ganglia.

The larvae of this genus are very close to those of *Elsianus*, and may be distinguished from some species of *Elsianus* by the absence of a dorso-lateral suture parallel to tergo-pleural suture on segments two to seven. Some species which appear to belong to the genus *Elsianus* have no dorso-lateral suture on the abdomen, and from these *Neoelmis* can only be distinguished by the nearly toothless anterior margin of the head and by counting the Malpighian tubules. The adults of *Neoelmis* differ so greatly from those of *Elsianus* in the structure of both their internal and external anatomy, that I consider the similarity of the larvae of these two genera to be due to parallelism.

HEXACYLLOEPUS, gen. n.

Body elongate, subparallel. Dorsal surface clothed with short, sparse or dense, usually recumbent hairs. Hairy or scale-like tomentum confined to the following areas: (1) genae; (2) hypomera with a large area which begins opposite middle of front coxae and extends transversely or obliquely upwards to lateral margin of pronotum and forms next to this margin a belt which frequently extends to anterior margin; (3) epipleura; (4) sides of prosternum, mesosternum, metasternum, and abdominal sternites, but in a few species nearly the entire ventral surface may be clothed with tomentum; and (5) all of legs except tarsi, though in most species the tomentum is sparse or absent on many parts of the tibiae and femora. *Head* when seen from below capable of being retracted so that none of the mouth-parts are visible. Antenna 11-segmented. Mandible with three acute apical teeth; prostheca entirely membranous and with the apex spinose or hairy. Maxillary palp 4-segmented and stipes with a well-developed palpifer; galea and lacinia separate and apex of each densely spinose. Labial palp 3-segmented and prementum with a palpiger. Mentum transverse and about as broad and long as submentum. Gula anteriorly nearly as broad as submentum but posteriorly slightly narrowed. *Pronotum* with a sublateral longitudinal carina on each side which generally extends from base to apex, though in a few species it does not quite reach either base or apex; with a median longitudinal impression on disk. *Elytra* striate and punctate; without accessory striae; with two sublateral carinae on each elytron. Hind wing (text-fig. 252)

without a radial cross vein and without an anal cell ; with the first anal absent ; second anal with the first and second branches present ; third anal with a second branch ; cubito-anal cross vein complete and joining cubitus to second anal. *Prosternum* very long in front of anterior coxae ; prosternal process long and posterior margin usually broadly rounded. Mesosternum with a deep and moderately narrow groove for the reception of the prosternal process. Metasternum with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae rounded and trochantin completely concealed by the hypomera. Claws without teeth. *Alimentary canal* with six caeca on the anterior margin of



TEXT-FIGS. 249, 250.—*Hexacylloepus smithi* (Grouvelle). (249) Male reproductive system. (250) Female reproductive system.

the mid-gut ; with the outer surface of the mid-gut smooth. Hind gut with four Malpighian tubules which end freely in the body cavity near the rectum. *Male reproductive system* (text-fig. 249) with the lateral accessory glands not divided. Each testis consisting of two sperm tubes. *Female reproductive system* (text-fig. 250) with seven egg tubes to each ovary. Spermathecal duct opening into apex of bursa copulatrix. *Central nervous system* with three thoracic discrete ganglia. First abdominal ganglion partly fused to third thoracic, two to five discrete, and six to eight partly fused together, though the limits of each are distinguishable.

GENOTYPE : *Elmis smithi* Grouvelle (1898).

H. smithi is the only member of this genus that has been available for an examination of the internal anatomy. The majority of the species are so close in external characters that they can be separated only on the structure of the

male genitalia which generally exhibit very striking specific differences. The larvae are still unknown.

The following species should be referred to *Hexacylloepus* Hinton: *H. abdominalis* (Hinton) (*Cylloepus*), *H. abditus* (Hinton) (*Cylloepus*), *H. aciculus* (Hinton) (*Cylloepus*), *H. ferruginea* (Horn) (*Cylloepus*), *H. flavipes* (Grouvelle) (*Cylloepus*), *H. granosus* (Grouvelle) (*Cylloepus*), *H. granulatus* (Sharp) (*Elmis*), *H. grouvellei* (Grouvelle) (*Cylloepus*), *H. horni* (Hinton) (*Cylloepus*), *H. indistinctus* (Hinton) (*Cylloepus*), *H. plaumanni* (Hinton) (*Cylloepus*), *H. subsulcatus* (Grouvelle) (*Cylloepus*), and *H. sulcatus* (Grouvelle) (*Cylloepus*).

On external characters this genus can be separated from *Cylloepus* only by having a complete transverse belt of tomentum on the hypomera. The internal anatomy, however, is not at all close to that of *Cylloepus*, differing as follows: (1) the anterior margin of the mid-gut has six instead of eight caeca; (2) the hind gut has only four instead of six Malpighian tubules; (3) the lateral accessory glands of the male are not divided into lobes; (4) each ovary has seven instead of about 18 egg tubes; and (5) the spermathecal duct opens into the apex instead of the base of the bursa copulatrix.

The species are confined to the Americas where they are found from the southern United States to south Brazil. They also occur in the West Indies.

The specific characters of most importance in separating the species are similar to those listed for *Cylloepus*. The following secondary sexual characters have been observed in the species before me.

- (1) Female with a broad depression on the apex of the fifth abdominal sternite (*abdominalis*).
- (2) Male with a long and acute tooth on the mesal margin of the hind coxa (sp. n., not yet described, BRAZIL).
- (3) Male with a row of close, stout, and short teeth on inner side of middle tibiae (*abditus*).

A KEY TO THE MEXICAN SPECIES OF *Hexacylloepus*.

1. Abdomen with an oval depression on the apex of the last sternite.

MEXICO	<i>H. apicalis</i> , sp. n.
Abdomen without a depression on the apex of the last sternite	2.
2. Median longitudinal impression of pronotum not present on basal fourth, or if present it is here very narrow and shallow so that it is scarcely noticeable. TEXAS *H. ferruginea* (Horn) (1870).

Median longitudinal impression of pronotum deep and broad on basal fourth	3.
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3. Male genitalia with the median lobe spatulate. MEXICO *H. scabrosus*, sp. n.

Male genitalia with the median lobe evenly narrowed to the apex; with a row of short and stout spines on ventral side of middle tibia	4.
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4. Male genitalia with the median lobe not twice as long as parameres.

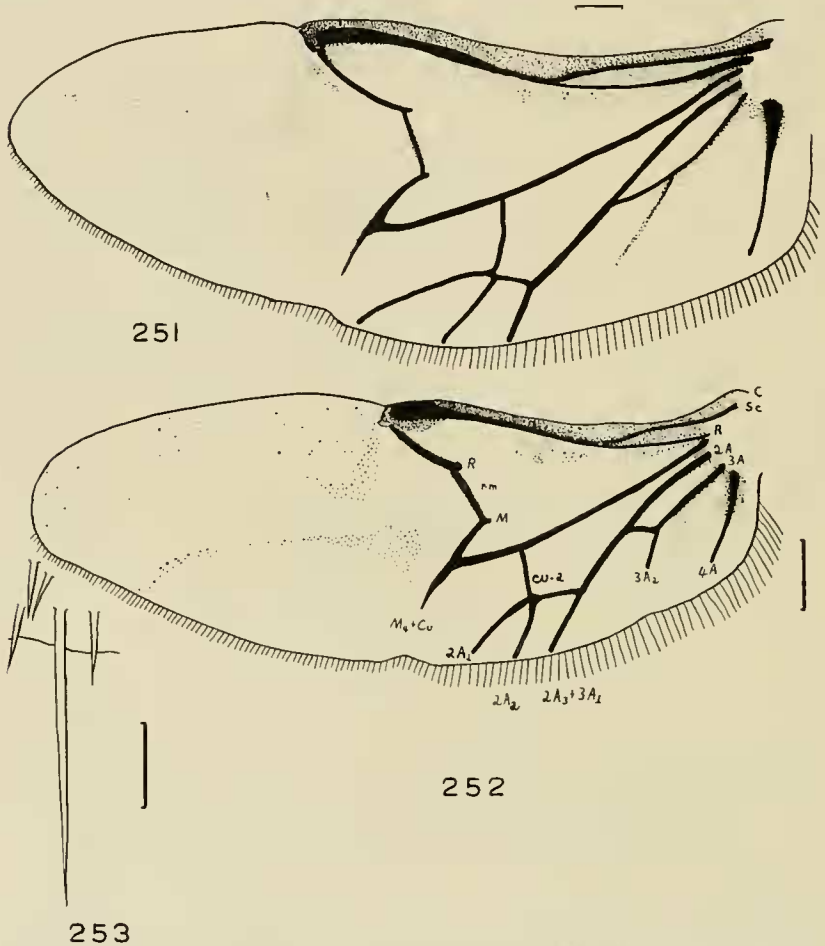
MEXICO	<i>H. abditus</i> (Hinton) (1937).
Males without a row of short and stout spines on ventral side of middle tibia. Male genitalia with the median lobe more than twice as long as parameres. MEXICO	<i>H. horni</i> (Hinton) (1937).

H. ferruginea (text-fig. 259) is included in this key, as it is already known from localities very near to the Mexican border and will undoubtedly be found in Mexico later on.

Hexacylloepus apicalis, sp. n.

(Text-figs. 252, 254-258.)

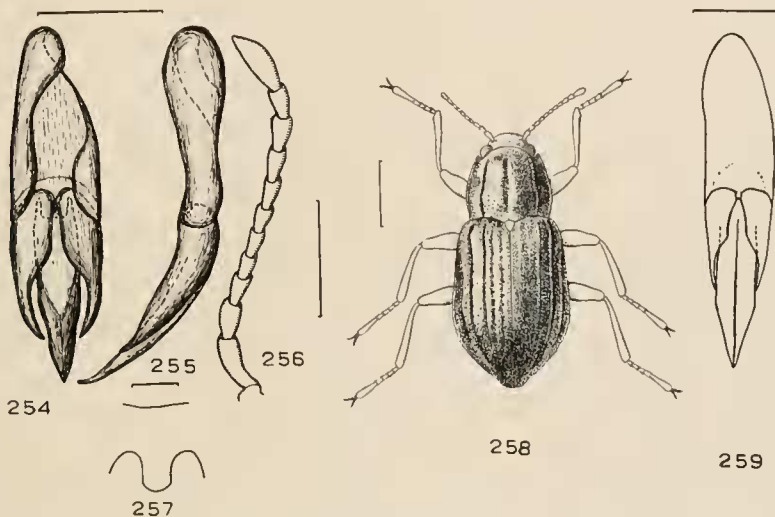
Male: Length, 1.8 mm.-1.95 mm.; breadth, 0.92 mm. Clothed with fine short (about 0.025 mm. long), recumbent, testaceous hairs which arise mostly at intervals equal to slightly less than their lengths; antennae similarly clothed



TEXT-FIGS. 251-253.—(251) Hind wing of *Cylloepus puncticollis* (Hinton). (252) Hind wing of *Hexacylloepus apicalis* Hinton. Venation after Forbes. (253) Microtrichia of apex near inner margin of wing of *C. puncticollis*.

but with the hairs sparser, slightly longer, and less recumbent; apical portion of labrum clothed with equally fine but longer (0.050 mm. or more) and paler hairs which are more erect, much denser, and usually confined to sides of labrum. Cuticle feebly shining and for the most part finely alutaceous; piceous to rufo-piceous; antennae, mouth-parts and legs somewhat rufo-testaceous; tomentum cinereous with golden reflections. *Head* with a feeble, broad, slightly oblique impression on each side near anterior half of eyes extending to a line drawn across

head from anterior margin of antennal cavities. Antennae as figured (text-fig. 256). Clypeus with the fronto-clypeal suture well impressed and transverse; anterior margin broadly and very feebly arcuately emarginate, with the angle on each side obtuse and bluntly rounded; sides feebly arcuate. Labrum with the anterior margin broadly and feebly rounded. Surface set with round to feebly oblong and apparently flat-topped granules, which are about as coarse or slightly coarser than facets of eyes and are mostly separated by less than a third to once their diameters; granules on clypeus finer; labrum without granules and with the very fine punctures separated by once to twice their diameters. *Pronotum* at broadest point which is near basal half broader than long (0.75 mm. : 0.62 mm.) and base broader than apex (0.65 mm. : 0.48 mm.). Apical margin as seen from above strongly arcuate at middle and deeply sinuate on each side before apical



TEXT-FIGS. 254-258.—*Hexacylloepus apicalis* Hinton. (254) Dorsal view of male genitalia. (255) Left lateral view of same. (256) Antenna. (257) Prosteronum. (258) Adult to show general appearance.

TEXT-FIG. 259.—*Hexacylloepus ferruginea* (Horn). Dorsal view of male genitalia.

angle behind eye; apical angles acute, strongly produced forwards and slightly inwards; sides moderately arcuate, slightly more strongly so at basal half and feebly sinuate before basal angles; lateral margins finely and rather regularly crenate, this crenation being due to granules placed on sides; basal angles acute, feebly produced outwards, inconspicuous; base trisinate, broadly and moderately strongly so on each side and shortly and very shallowly so in front of scutellum. *Pronotum* with the sublateral carina prominent, slightly converging towards apex, moderately strongly sinuate at basal half, and becoming obsolete at apical seventh; median longitudinal impression extending from near base to very near apex where it becomes obsolete, and broadest from basal fourth to apical half where it is slightly broader than scutellum. Surface apparently microscopically, confluent granulate throughout; also set with much larger granules as follows: sides between lateral margins and sublateral carinae with the granules about as fine as those of head, usually round and separated mostly by two to three times their diameters; granules on outer side of carinae slightly coarser, often more

oblong, and separated by about once their lengths; sides of disk near sublateral carinae granulate as area near lateral margins; area on each side of median impression with the granules slightly coarser and seldom separated by more than once their diameters; bottom of median impression without the coarser granules. Base of pronotum without oblique impressions; disk near situation of sublateral carinae with a very shallow, very broad, and indefinitely bounded impression. *Elytra* slightly more than twice as long as pronotum (1.40 mm. : 0.62 mm.) and feebly broadening posteriorly to broadest point which is at apical third and here broader than base of pronotum (0.92 mm. : 0.65 mm.). Apices feebly produced, conjointly broadly and feebly rounded. Lateral margins finely and regularly crenate, the crenation being due to fine lateral granules. Surface striate with the striae becoming finer towards apex and obsolete at apical fifth; discal striae punctures round to feebly subquadrate, moderately deep, about a half to a third as broad as intervals, and separated mostly by two to three times their diameters; these striae punctures become finer towards apex and are nearly obsolete at apex. Discal intervals feebly convex and subequal in breadth, at base all except sutural more strongly convex; surface of intervals without the microscopic granules of pronotum but with coarser granules similar to coarse ones of pronotum and generally slightly sparser; sublateral carinae similarly but more densely granulate. *Scutellum* flat, subovate, broader than sutural interval (0.10 mm. : 0.06 mm.), longer than broad (0.11 mm. : 0.10 mm.), feebly and broadly rounded basally, and slightly narrowed at apex; surface granulate similarly to adjacent portions of elytra. *Prosternum* with the process as figured (text-fig. 257); middle area of prosternum moderately coarsely and very densely granulate and subrugose; sides more finely, more sparsely, and less rugosely granulate. *Mesosternum* strongly depressed and with a large and deep median pit; surface more finely sculptured than surface of prosternum. *Metasternum* moderately depressed posteriorly, with a fine median longitudinal impression which is traceable nearly to anterior margin, sides with the granules finer and separated by two to three times their diameters. First abdominal sternite with the middle basal portion strongly depressed and the surface of the depression slightly less coarsely and rugosely granulate than metasternum; carinae of first sternite scarcely developed, very indistinct. Surface of sides of first sternite and all of other sternites with granules which are slightly finer than those of pronotum and usually separated by two to three times their lengths. Apex of last sternite with a large (about a third as long as segment), oval, moderately deep impression which is free of granules and somewhat polished. *Genitalia* as figured (text-figs. 254, 255).

Female: Externally similar to male.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*).

Paratypes: 176, collected at the same time as the type; and 1, MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vii. 1934 (*H. E. Hinton*).

Variations: The series before me is very uniform in size and structure, but there are slight differences in the density of the granules on the various sclerites, and the apical pit on the last abdominal sternite is subject to a slight variation in extent and depth.

Comparative notes: Both males and females of this species may be separated from all other species of the subgenus except *H. abdominalis* (*Hinton*) by the pit on the apex of the last abdominal sternite. The males of *H. abdominalis* have no pit on the apex of the abdomen, and the females may be distinguished

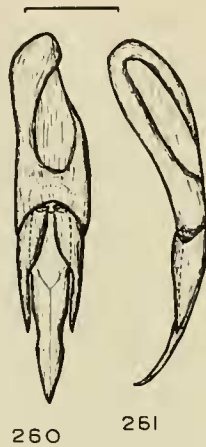
from both males and females of *apicalis* as follows: (1) the median longitudinal impression of the pronotum is not present on basal fourth in *abdominalis*, while on this part of the pronotum it is very distinct in *apicalis*; and (2) the sublateral carinae of the elytra are much less prominent in *abdominalis* than they are in *apicalis*. These two species are so widely separated geographically, one being from southern Brazil and the other from central Mexico, that there is little chance of their being confused in collections.

***Hexacylloepus scabrosus*, sp. n.**

(Text-figs. 260-261.)

Male: Length, 2.0 mm.; breadth, 0.95 mm. Clothed with fine, short (about 0.025 mm. long) recumbent, testaceous hairs which arise mostly at intervals equal to slightly less than their lengths; antennae similarly clothed but with the hairs much sparser (the vestiture of the antennae cannot be more accurately described, as all specimens before me are badly rubbed); apical portion of labrum clothed with equally fine but longer (0.050 mm. or more) and paler hairs which are more erect, much denser, and mostly confined to sides of labrum. Cuticle for the most part finely alutaceous and shining; piceous to rufo-piceous; antennae, mouth-parts, and legs paler rufo-piceous. Tomentum cinereous with golden reflections. *Head* with a feeble, broad, slightly oblique impression on each side near anterior half of eyes extending to slightly behind an imaginary line drawn across head from anterior margin of antennal cavities. Clypeus with the fronto-clypeal suture nearly straight and well impressed; anterior margin very broadly and very feebly arcuately emarginate; angle on each side obtusely and bluntly rounded; sides feebly arcuate. Labrum with the anterior margin broadly rounded in front, with the angle on each side broadly rounded. Surface set with round to feebly oblong granules which are apparently flat-topped, as coarse as facets of eyes, and separated mostly by less than a third to once their lengths; granules on clypeus slightly finer; labrum without granules and punctate with very fine, microscopic punctures which are separated mostly by once to twice their diameters. *Pronotum* at broadest point near basal half broader than long (0.82 mm. : 0.70 mm.) and base broader than apex. Apical margin as seen from above moderately arcuate at middle and broadly and deeply sinuate on each side behind eye before apical angles; apical angles acute, strongly produced forwards and slightly inwards; sides moderately arcuate, slightly more strongly so at basal half and scarcely noticeably sinuate before basal angles; lateral margins finely and rather regularly crenate, this crenation being due to granules placed on sides; basal angles feebly acute, nearly rectangular, and feebly produced backwards; base trisinate, broadly and moderately strongly sinuate on each side and shortly and very shallowly sinuate in front of scutellum. Pronotum with the sublateral carina prominent, slightly converging towards apex, moderately sinuate at basal half, and becoming obsolete at apical seventh; median longitudinal impression extending from near base to near apex where it becomes obsolete, broadest from basal fourth to apical third where it is slightly broader than scutellum; base of pronotum without oblique impressions; disk near sinuation of sublateral carina with a very shallow and broad indefinitely bounded impression. Surface of pronotum microscopically alutaceous so that it appears to be minutely and confluent granulate throughout; also set with granules as follows: side between lateral margins and sublateral carina about as fine as those of head, usually round, and separated mostly by two to three times their diameters;

granules on outer sides of sublateral carina slightly coarser and usually separated by about once their diameters; sides of disk near sublateral carina granulate similarly to but more densely than area near lateral margin; area on each side of median impression with granules about as coarse as those on sides of sublateral carina and about equally dense. *Elytra* twice as long as pronotum (1.4 mm. : 0.70 mm.) and very feebly broadening posteriorly to broadest point which is at apical third (here appearing scarcely broader than across humeri) which is broader than base of pronotum (0.95 mm. : 0.71 mm.). Apices moderately produced, conjointly broadly and feebly rounded, subtruncate. Lateral margins finely and regularly crenate, the crenation being due to lateral granules. Surface striate with the striae becoming finer towards apex and nearly obsolete beyond apical fourth; discal strial punctures round to feebly subquadrate, deep, about a third to a half as broad as intervals, and separated longitudinally by two to three times



TEXT-FIGS. 260, 261.—*Hexacylloepus scabrosus* Hinton. (260) Dorsal view of male genitalia. (261) Left lateral view of same.

their diameters though occasionally they are more closely placed; these punctures become finer towards apex and are nearly obsolete at apex. Discal intervals feebly convex and subequal in breadth, at base all except sutural more strongly convex; surface of intervals with the alutaceous microsculpture not similar to that of pronotum; also set with granules which are slightly coarser and sparser but otherwise similar to those of pronotal disk; sublateral carinae slightly more densely granulate but with the granules here as elsewhere on elytra mostly round. *Scutellum* flat, subovate, broader than sutural interval (0.10 mm. : 0.06 mm.), longer than broad (0.11 mm. : 0.10 mm.), feebly and broadly rounded basally, and slightly narrowed at apex; surface granulate similarly to adjacent portion of elytra. *Prosternum* with the margins of the process somewhat raised so that the median area appears slightly concave at middle; middle area of prosternum moderately coarsely and very densely rugosely granulate; sides more finely, more sparsely, and also less rugosely granulate. *Mesosternum* strongly depressed and with the median pit deep and large; surface slightly more finely sculptured than middle area of prosternum. *Metasternum* moderately feebly depressed posteriorly; with a fine median longitudinal impression which

is traceable nearly to anterior margin; disk sculptured as middle area of prosternum; sides with the granules slightly finer and separated by two to three times or more than their diameters. First abdominal sternite with the middle basal portion moderately depressed and here with the surface nearly as coarsely and rugosely granulate as that of disk of metasternum; carinae of first sternite not evident; sides of basal sternite and entire surface of other sternites with granules which are slightly finer than discal pronotal ones and are usually separated by two to three times their diameters. *Genitalia* as figured (text-figs. 260, 261).

Female: Externally similar to male.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*).

Paratypes: 2 ♂♂ and 1 ♀ with same data as type.

Variations: In the small series before me no variations have been observed.

Comparative notes: This species is nearly identical in external characters to *H. apicalis*, as may be seen from a comparison of the two descriptions. The only external difference which can be relied on to distinguish the two is the apical abdominal pit of both sexes of *apicalis*. The four specimens before me have the prosternal process more strongly concave along the middle and the margins of the process more thickly and strongly raised than is the case in *apicalis*, but these slight differences may be bridged when a longer series is studied.

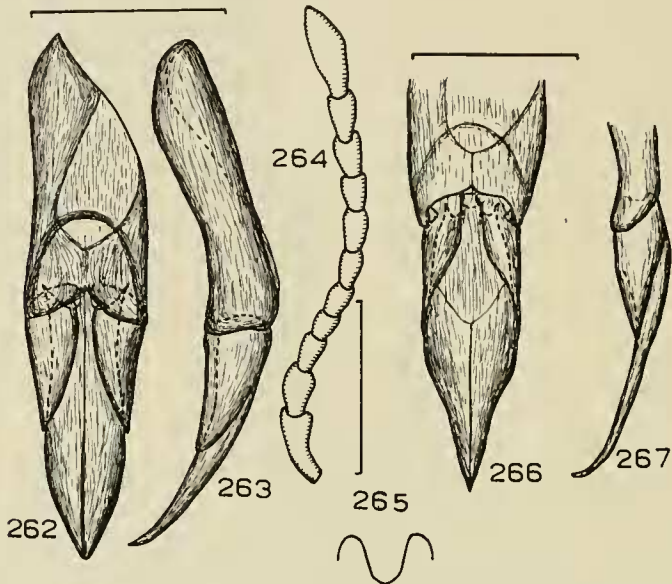
Hexacylloepus abditus (Hinton).

(Text-figs. 262-265.)

1937. *Cylloepus abditus* Hinton, *Arb. morph. taxon. Ent. Berlin-Dahlem*, 4 (2): 106, figs. 13-16.

Male: Length, 1.7 mm.; breadth, 0.77 mm. Clothed with fine, short (about 0.025 mm. long), recumbent, testaceous hairs which arise mostly at intervals equal to slightly less than their own lengths; antennae similarly clothed but with the hairs sparser and less recumbent; apical portion of labrum clothed with equally fine but longer (about 0.050 mm., but occasionally about 0.062 mm.) and paler testaceous hairs which are more erect, much denser, and usually confined to sides of apical portion. Cuticle for the most part finely alutaceous and shining; piceous to rufo-piceous; antennae, mouth-parts and legs paler. Tomentum cinereous with golden reflections. *Head* with a feeble, broad, slightly oblique impression extending on each side near anterior half of eyes to a point opposite anterior margins of antennal cavities. Clypeus with the fronto-clypeal suture nearly straight and well impressed; anterior margin broadly and feebly arcuately emarginate, with the angle on each side broadly rounded and the sides feebly arcuate. Labrum broadly and feebly rounded in front, with the angle on each side broadly rounded. Surface set with round to feebly oblong, flat-topped granules which are nearly as coarse as facets of eyes and are usually separated by twice their diameters though often by much less; granules on clypeus finer and denser; labrum without granules but punctate with fine, microscopic punctures which are mostly separated by once to twice their diameters. *Pronotum* at broadest point which is near basal half broader than long (0.062 mm. : 0.52 mm.) and base broader than apex (0.57 mm. : 0.42 mm.). Apical margin as seen from above moderately strongly arcuate at middle and deeply sinuate on each side behind eye before apical angle; apical angles moderately acute, moderately strongly produced forwards and slightly inwards;

sides moderately arcuate but slightly more strongly so at basal half, scarcely noticeably sinuate just before basal angles. Lateral margins feebly and rather regularly crenate, this crenation being due to granules placed on sides; basal angles acute and very feebly produced backwards; base trisinuate, broadly and deeply so on each side and shortly and more shallowly sinuate in front of scutellum. *Pronotum* with the sublateral carina prominent, slightly converging towards apex, moderately strongly sinuate on basal half, and becoming obsolete at about apical fourth; median longitudinal impression extending from near base to near apex where it becomes obsolete and broadest from basal fourth to apical third, where it is slightly broader than scutellum; base of pronotum without oblique



TEXT-FIGS. 262-267.—(262) Dorsal view of male genitalia of *Hexacylloepus abditus* (Hinton). (263) Left lateral view of same. (264) Antenna. (265) Prosternum. (266) Dorsal view of male genitalia of *Hexacylloepus horni* (Hinton). (267) Left lateral view of same.

impressions; disk near situation of sublateral carina with a shallow, broad, indefinitely bounded impression. Surface microscopically alutaceous in such a manner as to appear confluent granulate throughout; also set with distinct granules as follows: Sides between sublateral carinae and lateral margins set with granules about as fine as those of head, usually round, and separated mostly by two to three times their diameters; granules on outer sides of sublateral carinae slightly coarser and usually separated by once to twice their diameters; sides of disk near sublateral carina granulate as area near lateral margin; area near median impression with the granules slightly coarser and denser than those of sides of disk. *Elytra* more than twice as long as prothorax (1.18 mm. : 0.52 mm.) and feebly broadening posteriorly to broadest point, which is at apical third and is broader than base of pronotum (0.77 mm. : 0.57 mm.). Lateral margins finely and regularly crenate, the crenation being due to fine lateral granules. Surface with the striae becoming finer towards apex and all except sutural obsolete

beyond apical sixth; discal stria punctures round to feebly subquadrate, moderately deep, about a third to a half as broad as intervals, and separated longitudinally usually by two to three times their diameters; these stria punctures become finer towards apex and at apical fifth they are shallow, sparse, and only about a third to a sixth as coarse as discal intervals; discal intervals subequal in breadth and feebly convex, at base with the fourth interval more strongly convex (there is much variation in this respect and sometimes none are convex); surface of intervals at base alutaceous somewhat as on pronotum but elsewhere on elytra the microsculpture does not appear granulate; granules mostly similar in size and density to those of pronotum; granules on carinate intervals slightly larger and denser but also round to feebly oblong as elsewhere on elytra. Apices moderately produced, conjointly broadly and very feebly rounded. *Scutellum* flat, subovate, broader than sutural interval (0.09 mm. : 0.06 mm.), longer than broad (0.10 mm. : 0.09 mm.), feebly and broadly rounded basally, and slightly narrowed to apex; surface granulate similarly to adjacent portion of elytra. *Prosternum* with the process as figured (text-fig. 265) and feebly concave with the lateral margins somewhat raised; middle area of prosternum with the granules as coarse as those of elytra but with the surface also densely rugose, at sides much less rugose and with the granules finer and sparser. *Mesosternum* strongly depressed and with a median pit at the bottom of the depressed area. *Metasternum* moderately strongly depressed posteriorly; with a fine, median longitudinal line which is traceable to nearly anterior margin; disk sculptured as middle area of prosternum but with the granules usually slightly larger; sides less rugose and with the granules sparser. Middle portion of first abdominal sternite moderately strongly depressed and with the surface of this depression sculptured as sides of metasternum; first sternite without obvious carinae; sides of first sternite and all of surface of other sternites with granules which are about as coarse as discal pronotal ones and are usually separated by less than to twice their lengths. Middle tibiae with a row of small, short, stout, and close teeth on ventral side. *Genitalia* as figured.

Female: Externally similar to male but without the row of spines on the ventral side of middle tibiae.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Tejunpilco, alt. about 4000 ft., vi. 1934 (*H. E. Hinton*).

Specimens examined: 56, with same data as type but collected on 16. vi. 1933 (*H. E. Hinton, R. L. Usinger*).

Variations: No variations worthy of mention have been noted in the series available.

Comparative notes: The males of this species may be distinguished from those of *H. scabrosus* by the row of fine teeth on the middle tibiae and the differently formed male genitalia, but the females, as far as I know, are inseparable. *H. abditus* and *H. scabrosus* have not yet been found to overlap geographically.

Hexacylloepus horni (Hinton).

(Text-figs. 266, 267.)

1937. *Cylloepus horni* Hinton, *Arb. morph. taxon. Ent. Berlin-Dahlem*, 4, (2) : 109, figs. 17, 18.

Male: Length, 1.7 mm.; breadth, 0.80 mm. I have written a description of nearly 1000 words for this species, but a comparison of this description with

that of *abditus* shows that the two are identical in nearly every respect, so that to give the description of *horni* here would be a waste of space. For an understanding of the external characters of this species the student is referred to the description of *abditus*. The males of the new species differ from those of *abditus* by not having a row of short teeth on the ventral side of the middle tibiae and by the structures of the male genitalia (*cf.* figs.). Both males and females of the two species may be readily separated by the differences in the length of the legs. The following table is drawn up from a male specimen of each equal in length and very nearly equal in breadth :

	Front femora.	Front. tibiae.	Middle femora.	Middle tibiae.	Hind femora.	Hind tibiae.
<i>abditus</i>	0·375 mm.	0·425 mm.	0·40 mm.	0·437 mm.	0·437 mm.	0·500 mm.
<i>horni</i>	0·425 mm.	0·487 mm.	0·512 mm.	0·587 mm.	0·537 mm.	0·650 mm.

Female : Externally similar to male.

Type : ♂ in the British Museum (Nat. Hist.). MEXICO : Dist. de Temascaltepec, Tejupilco, alt. 3500-4000 ft., vii. 1934 (*H. E. Hinton*).

Specimens examined : 2, MEXICO : Sierra de Durango, 1922 (*C. Schaufuss*).

Comparative notes : Apart from the characters of the male genitalia, this species is inseparable from *H. scabrosus*. The latter has the length of the legs intermediate between *abditus* and *horni*.

CYLLOEPUS Erichson.

1847. *Cylloepus* Erichson, *Naturges. Ins. Deutschl.*, 3 : 521.

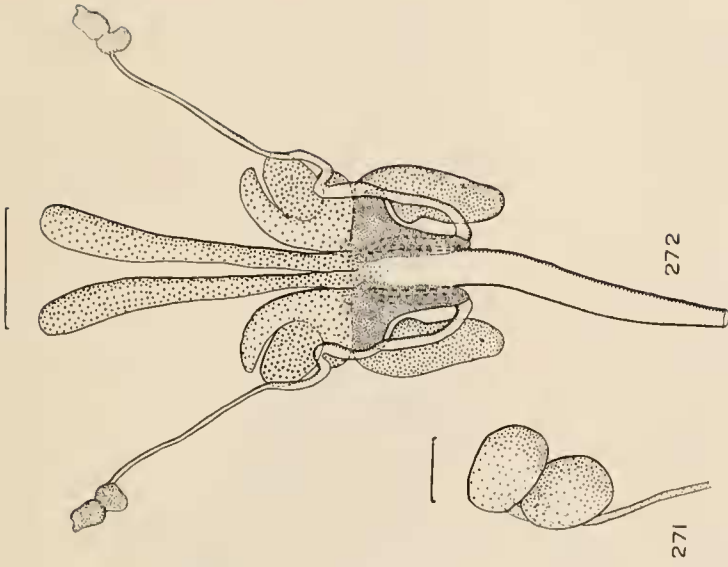
1854. *Cylloepus* Lacordaire, *Gen. Col.*, 2 : 510.

1882. *Cylloepus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 129.

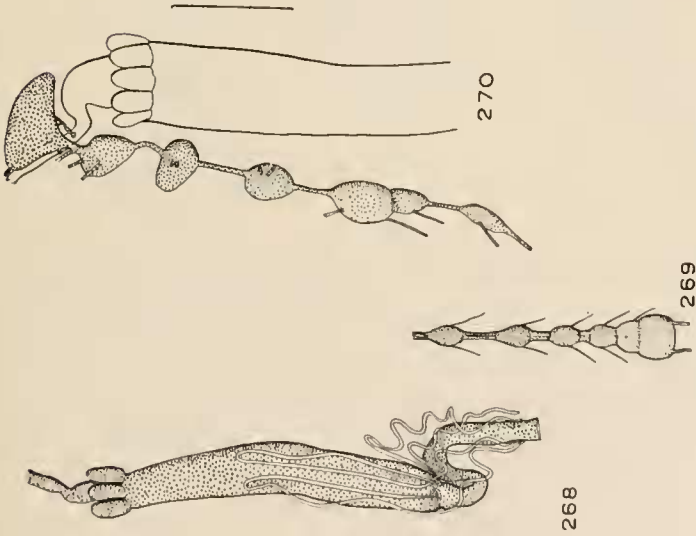
This genus was erected by Erichson (1847) to contain *Limnius araneolus* Müller (1806) of Peru. Erichson had before him a male of *C. araneolus*, and a good proportion of his brief generic diagnosis is devoted to describing the apical segment of the labial palpus which in this, as well as in the males of many other species of *Cylloepus*, is very much broadened at the apex.

The generic limits of this genus have been little understood. Grouvelle correctly assigned five species to this genus and described many others as species of *Elmis* Latreille and one as an *Elsianus* Sharp. Sharp (1882) in his work on the Central American Elmidae correctly referred one species to *Cylloepus* and placed a number of others in *Elmis* Latreille. Darlington (1927) described a number of West Indian forms under the name of *Elmis*. These species were later correctly placed in *Cylloepus* by Musgrave (1935), but were again assigned to *Elmis* by Darlington (1936). A redescription of *Cylloepus* (*sensu stricto*) follows :

Body elongate, subparallel. Dorsal surface clothed with short, sparse or dense, usually recumbent hairs. Tomentum confined to the following areas : (1) genae ; (2) epipleurae ; (3) sides of prosternum, mesosternum, metasternum, and abdominal sternites, but in a few species nearly the entire ventral surface may be clothed with scale-like or hairy tomentum ; and (4) all of legs except tarsi, though in most species the scale-like tomentum is sparse or absent on the tibiae. The hypomera are nearly always without a trace of tomentum, and only rarely is there a very narrow belt of tomentum along the anterior portion of the sterno-pleural suture. *Head* when seen from below capable of being retracted, so that none of the mouth-parts is visible. Antennae 11-segmented. Mandible

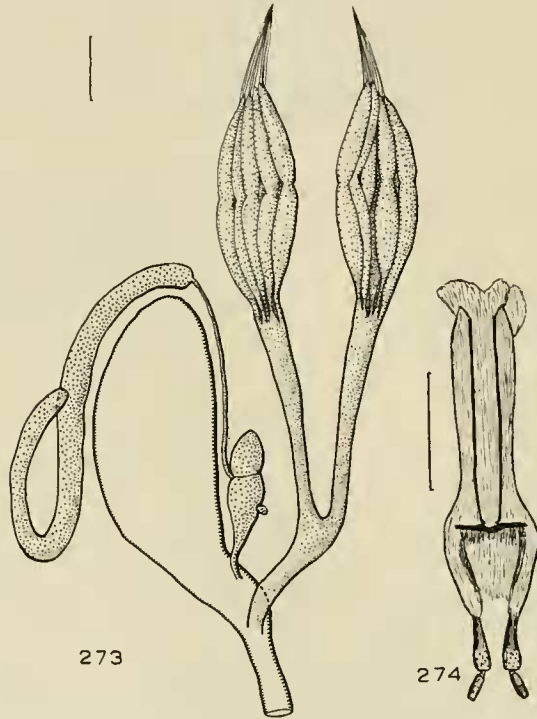


TEXT-FIGS. 271, 272.—*Cylloepus consobrinus* Grouvelle, (271) Enlarged view of sperm tubes of sexually mature specimen, (272) Male reproductive system.



TEXT-FIGS. 268-270.—*Cylloepus consobrinus* Grouvelle, (268) Alimentary canal, (269) Posterior portion of central nervous system, (270) Lateral view of anterior portion of central nervous system.

with three acute apical teeth; prostheca large, entirely membranous and with the apex spinose or hairy. Maxillary palp 4-segmented and stipes with a well-developed palpifer; galea and lacinia separate and apex of each densely spinose. Labial palp 3-segmented and prementum with a palpiger. Mentum transverse and about as broad and long as submentum. Gula anteriorly nearly as broad as submentum and slightly narrowed posteriorly. *Pronotum* with a sublateral longitudinal carina on each side generally extending from base to apex, though in a few species this carina does not quite reach either base or apex; with a median longitudinal impression on the disk; with a shallow impression which



TEXT-FIGS. 273, 274.—(273) Female reproductive system of *Cylloepus consobrinus* Grouvelle. (274) Female genitalia of *Cylloepus puncticollis* (Hinton).

extends obliquely outwards from base on each side of scutellum to sublateral carina which it bisects at about basal third. *Elytra* striate and punctate; without accessory striae; and with two or very rarely (*sculptipennis* Sharp) one sublateral carina. Hind wing (text-fig. 251) without a radial cross vein and without an anal cell; with the first anal absent; second anal with the first and second branches present; third anal with a second branch; cubito-anal cross vein complete and joining cubitus to second anal. *Prosternum* (text-fig. 278) very long in front of anterior coxae; prosternal process long and posterior margin usually broadly rounded. Mesosternum with a deep and moderately narrow groove for the reception of the prosternal process. Metasternum with a median longitudinal impressed line. *Legs* with the visible portion of the coxae rounded and trochantin completely concealed by the hypomera. Claws without teeth. *Alimentary canal* (text-fig. 268) with eight caeca on the anterior margin of the

mid-gut. Hind gut with six Malpighian tubules which end near the rectum freely or imbedded in fatty tissue. *Male reproductive system* (text-fig. 272) with the lateral accessory glands divided into several lobes. Each testis of two sperm tubes. Female reproductive system (text-fig. 273) with about 18 egg tubes to each ovary. Spermathecal duct opening at base of bursa copulatrix. *Central nervous system* with three discrete thoracic ganglia. First abdominal ganglion partly fused to third thoracic; two to five free; and six to eight partly fused together, though the limits of each are distinguishable.

GENOTYPE: *Limnius araneolus* Müller (1806).

The internal anatomy of three species has been examined and found to agree in essential details. *C. consobrinus* Grouvelle of Bolivia is figured.

In external appearance this genus is very close to *Stenelmis* Dufour from which it may be distinguished as follows: (1) There is no accessory stria on each elytron at base between the first and second striae; (2) the inner apex of each tibia is densely pubescent, while in *Stenelmis* this part of the tibia is without a fringe of hairs; and (3) there are only two instead of three sperm tubes to each testis.

This genus is confined to the Americas, where it occurs from Southern United States to Chili and is well represented in the West Indies.

The specific characters of greatest importance in separating the species of *Cylloepus* seem to be the following:

- (1) General proportions, length and breadth.
- (2) Size and density of the punctures of all the sclerites and the type of microsculpture between the punctures.
- (3) Extent and depth of the impressions on the head.
- (4) Condition of fronto-clypeal suture.
- (5) Anterior margin of clypeus, whether truncate, rounded, or emarginate, and shape of angle on each side.
- (6) Condition of anterior margin of labrum.
- (7) Colour. In many species the antenna is bicoloured.
- (8) Outline of pronotum and the extent and depth of the various impressions on its surface. Shape and extent of the sublateral carinae.
- (9) Shape of elytral apices.
- (10) Condition of lateral margin of elytra, whether crenate or smooth.
- (11) Number of sublateral elytral carinae and number of carinate or convex intervals.
- (12) Depth and extent of striae and stria punctures.
- (13) Shape of scutellum and if convex or flat.
- (14) Shape of prosternum and prosternal process.
- (15) Impressions on disk of metasternum.
- (16) Condition of carinae on first abdominal sternite.
- (17) Extent and depth of depression on middle of first abdominal sternite.
- (18) If a depression is present on the second abdominal sternite its depth and extent should be described carefully.
- (19) Depth and extent of depression sometimes present on apex of fifth abdominal sternite.
- (20) Secondary sexual characters. These are, as in most genera of the family, among the most highly specific characters.
- (21) Structure of the male genitalia. The structure of this organ is more important than that of any other in associating specimens with specific descriptions. Unless a species is exceptionally distinct, it should not be described without illustrating the genitalia.

Secondary sexual characters are abundant in *Cylloepus*, and the following have been observed in the species before me.

- (1) Male with the apex of the last segment of the labial palp very much broadened (*araneolus*, *barberi*, *consobrinus*, *palpalis*, *puncticollis*, *optatus*).
- (2) Male with the mesosternum on each side of the middle with a strong gibbosity, at the apex of which is a group of erect hairs, while in the female this portion is only slightly convex and without hairs (*spinipes*).
- (3) Disk of metasternum not as strongly nor as broadly depressed in the females as in the males (most species).
- (4) Female with an acute tubercle on each side of metasternum in front of mesal margin of hind coxa (*ventralis*).
- (5) First abdominal sternite at middle more strongly depressed in male than in female (most species).
- (6) Male with the carinae of first abdominal sternite more convex than those of female and curving inwards while in the female they are straight (*sculptipennis*).
- (7) Male with the carinae of the first abdominal sternite relatively longer than those of the female (*sculptipennis*).
- (8) Second abdominal sternite depressed in male and convex or flat in female (*sculptipennis*, *sexualis*).
- (9) Male without a tooth-like tubercle on mesal margin of hind coxa (*spinipes*).
- (10) Male with three large teeth on ventral apical fourth of front tibia (*spinipes*).
- (11) Male with a carina-like swelling on inner side of front tibia near apex (*sexualis*).
- (12) Male with a row of close, stout, and short teeth on inner side of middle tibiae (*barberi*, *optatus*, *sexualis*).
- (13) Male with a large and flat tooth on inner half of hind tibia (*spinipes*).
- (14) Male with the hind tibia at middle of its length more swollen and curved than that of the female (*optatus*, *sexualis*).
- (15) Male with numerous pale and erect hairs on the ventral surface of the first four segments of the front tarsi (*optatus*).

A KEY TO THE MEXICAN SPECIES OF *Cylloepus*.

1. Elytra on each side with only one distinct sublateral carina. GUATEMALA, MEXICO *C. sculptipennis* (Sharp) (1882).
Elytra with two distinct sublateral carina on each side 2.
2. Base of pronotum in front of scutellum with an impression which is about as broad as scutellum and half as deep. Elytra with the basal discal intervals flat and with the surface of the intervals not granulate. GUATEMALA, COSTA RICA *C. barberi* Hinton (1934).
Base of pronotum in front of scutellum without an impression; or if one is present it is very shallow and scarcely noticeable. Elytra with the basal discal intervals always granulate if flat 3.
3. Elytra with none of the basal discal intervals strongly convex. MEXICO *C. blairi* Hinton (1936).
Elytra with one or more of the basal discal intervals strongly convex 4.
4. Elytra with the fourth discal interval strongly convex at base 5.
Elytra with the fourth discal interval flat 7.

- 5. Elytra with the third discal interval flat. GUATEMALA, MEXICO
C. heterocerus (Sharp) (1882).
 Elytra with the third discal interval near base nearly or more strongly convex than fourth 6.
- 6. Apical segments of antennae black, or if not black at least distinctly darker than the two basal segments. Pronotum with the disk punctate on either side of median longitudinal impression. Males with the last segment of the labial palp very much broadened at apex; metasternal disk only feebly depressed; abdomen with the first sternite depressed at middle from base to apex; front and hind tibiae without spines. MEXICO *C. puncticollis* (Hinton) (1934).
 Antennae unicolorous. Pronotum with the disk granulate on either side of the median longitudinal impression. Males with the last segment of the labial palpi not strongly broadened at apex; metasternal disk strongly depressed; abdomen with the first sternite depressed at middle only on basal three-fourths; front tibiae on inner apical fourth with three spines, and hind tibiae on inner side at basal two-fifths with a large flat spine. MEXICO *C. spinipes* Hinton (1934).
- 7. Elytra with the fifth interval near base strongly convex for a short distance. Males with a short and prominent carina-like swelling on inner apical fourth of front tibiae. MEXICO *C. sexualis* Hinton (1937).
 Elytra with the fifth interval near base at most feebly convex. Males without a carina on inner apical side of front tibia 8.
- 8. Antennae with the two basal segments pale rufo-piceous and the others piceous to black. Males with the four basal segments of the front tarsi not densely clothed with erect hairs on the ventral side; abdomen with the middle of the second sternite at most feebly depressed on extreme base. MEXICO. *C. proximus* Hinton (1937).
 Antennae unicolorous. Males with the four basal segments of the front tarsi clothed on ventral side with moderately long, erect, and pale hairs; abdomen with the middle of the second sternite moderately strongly depressed on basal two-thirds. PANAMA, GUATEMALA, COSTA RICA *C. optatus* Sharp (1882).

Two species, *C. barberi* Hinton and *C. optatus* Sharp, which are widely distributed in Central America are included in the key given above, as they may be found in Mexico when this country is more thoroughly explored.

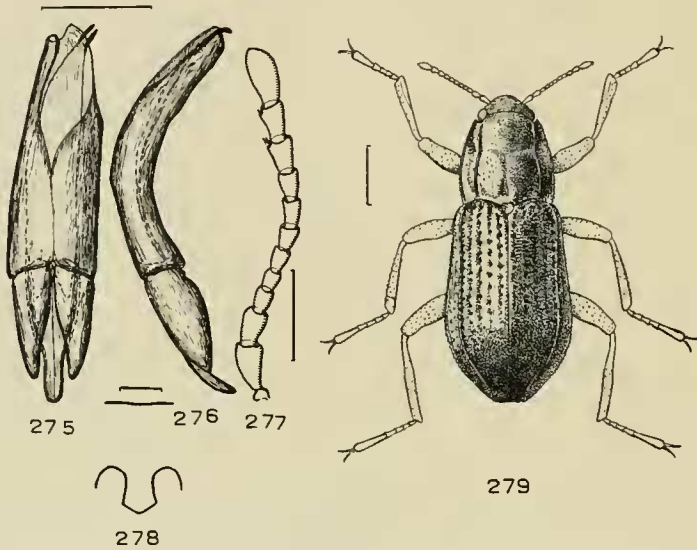
***Cylloepus sculptipennis* (Sharp).**

(Text-figs. 275-279.)

1882. *Elmis sculptipennis* Sharp, *Biol. Centr.-Amer. Col.*, I (2) : 135.

Male: Length, 2.8 mm.; breadth, 1.12 mm. Subparallel, moderately convex. Clothed with fine, recumbent, brownish hairs which are about 0.05 mm. long and arise at intervals equal to more than once their lengths; labrum at sides with the hairs much longer and denser and paler. Cuticle shining and rufo-piceous to nearly black; densely and minutely alutaceous on head, pronotum, hypomera, prosternal process, meso- and metasternum, all of first abdominal sternite, and sides of sternites two to five. *Head* without distinct impressions; surface densely and very minutely alutaceous so that under a

magnification of $\times 150$ it appears to be finely granulate; also set with low and irregularly shaped granules which are slightly finer than facets of eyes and are usually separated by less than to twice their diameters. Clypeus when viewed from in front with the anterior margin feebly and arcuately emarginate for its entire breadth, with the angle on each side broadly rounded; clypeal suture feeble and arcuate; surface similar to that of head but with only the base and sides alutaceous. Labrum with the anterior margin truncate and the angle on each side feebly rounded; surface with punctures which are not more than half as broad as granules of clypeus and are usually separated by less than to once their diameters. *Pronotum* with the broadest point at basal two-fifths and here broader than long (0.85 mm. : 0.80 mm.) and base broader than apex (0.80 mm. : 0.54 mm.). General shape and form and extent of the various impressions as



TEXT-FIGS. 275-279.—*Cylloepus sculptipennis* (Sharp). (275) Dorsal view of male genitalia. (276) Right lateral view of same. (277) Antenna. (278) Prosternum. (279) Adult to show general appearance.

figured (text-fig. 279). Surface sculptured as head except for area near inner side of sublateral carinae on basal half, extreme base, and sides near lateral margins which are only feebly or not at all alutaceous. *Elytra* more than twice as long as prothorax (1.87 mm. : 0.80 mm.) and feebly broadening posteriorly to broadest point which is near apical third and which is distinctly broader than broadest point across humeri (1.12 mm. : 1.00 mm.). Lateral margins coarsely and densely crenate. Surface coarsely striate, discal striae finer and shallower as they approach apex but never altogether absent; discal strial punctures subquadrate to round, moderately deep, and at middle of disk as broad as intervals to slightly narrower and separated longitudinally by slightly more than to slightly less than their own diameters; towards sides the punctures become coarser and denser and towards apex finer and sparser. Discal intervals flat, the third at base being only very slightly convex. *Elytra* with only one sublateral carina. Surface of intervals with the granules slightly larger, more convex, and more regularly round than those of pronotum and separated usually by one to four

times their diameters; sutural interval on basal two-thirds and first four intervals on apical third with only an occasional granule; surface between granules with punctures similar to those of labrum but separated by one to five times their diameters. *Scutellum* flat, subovate, broader than sutural interval near base (0.12 mm. : 0.05 mm.) and as broad as long; surface sculptured as adjacent elytral intervals. *Prosternum* with the anterior two-thirds (not including process) moderately strongly but not sharply lobed; surface granulate as elytral intervals except for surface of process which is sculptured as head. Hypomera very densely and regularly alutaceous, with only an occasional granule, and without tomentum. Mesosternum sculptured as prosternal process. Metasternum with the posterior third of disk only feebly depressed; with a broad (about 0.03 mm.) and deep median longitudinal impression which extends to apical fourth; surface of disk similarly but distinctly more coarsely sculptured than surface of prosternal process; sides of metasternum with the granules only showing through the tomentum and separated by one to three times their diameters, the surface here strongly resembling that of the legs. Abdomen with the carinae of the first abdominal sternite curving slightly inwards, complete from base to apex, and most prominent at apex; first sternite at middle strongly depressed, this depression very shallowly but nevertheless distinctly encroaching to middle of basal third of second sternite; middle of first sternite on basal two-thirds densely and minutely alutaceous and with deep round punctures which are about 0.02 mm. broad and are contiguous to separated by once their diameters; apical third of first sternite and all of middle up to apical four-fifths of fifth sternite not alutaceous and with the punctures similar to those of first sternite, but becoming progressively finer as apex of abdomen is approached so that on basal fifth of fifth sternite they are only half as coarse. Sides of abdominal sternites granulate as sides of metasternum. *Genitalia* as figured (text-figs. 275, 276).

Female: Externally similar to male except as follows: (1) the carinae of the first abdominal sternite straight and not curved inwards, absent on apical sixth, and least instead of most prominent at apex; and (2) the depression of the middle of the first sternite does not extend on to second sternite.

Type: In the British Museum (Nat. Hist.). GUATEMALA: Rio Naranjo, 450 ft. (*Champion*).

Specimens examined: 8, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*); 2, MEXICO: Dist. de Temascaltepec, alt. 6000-7000 ft., vi. 1934 (*H. E. Hinton*); and 1 with same data as above but at Tejupilco, alt. about 4000 ft., vii. 1934.

Variations: No variations worthy of mention have been noted.

Comparative notes: This is the only species of *Cylloepus* known to-day which has only one sublateral elytral carina, the usual outer one being completely absent. In general appearance it is close to *C. blairi* Hinton. The mouth-parts and wing venation are like those of typical members of the genus.

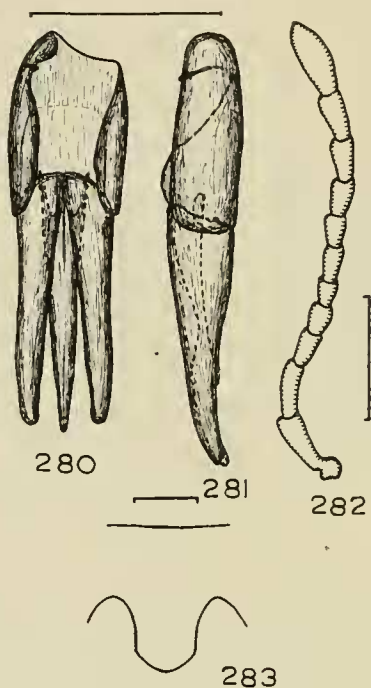
***Cylloepus blairi* Hinton.**

(Text-figs. 280-283.)

1936. *Cylloepus blairi* Hinton, *Ent. mon. Mag.*, 72: 1, figs. 1-4.

Male: Length, 3.0 mm.; breadth, 1.2 mm. Subparallel, moderately convex. Clothed with fine, short (about 0.037 mm. long), recumbent, brownish-testaceous hairs which arise mostly at intervals equal to about their own lengths;

antennae (all specimens before me are badly rubbed) with a few equally fine but more erect hairs at apical angles of segments; apical portion of labrum with equally fine but much longer (often 0.06 mm.) hairs which are apparently confined to the sides; beneath with the hairs generally finer and shorter but otherwise similar. Cuticle moderately shining and for the most part finely alutaceous; piceous to rufo-piceous; tomentum of body cinereous with golden reflections. *Head* on each side near anterior one-half of eyes with a feeble, scarcely noticeable, broad and oblique impression. Antennae as figured (text-fig. 282). Clypeal suture well-marked; anterior margin of clypeus very broadly and very feebly



TEXT-FIGS. 280-283.—*Cylloepus blairi* Hinton. (280) Dorsal view of male genitalia. (281) Right lateral view of same. (282) Antenna. (283) Prosternum.

arcuately emarginate; angle on each side obtusely rounded; sides feebly arcuate. Labrum broadly and feebly rounded in front, nearly truncate; anterior angles broadly rounded. Surface with the alutaceous microsculpture appearing confluent granulate; set with usually round granules which are about as coarse as facets of eyes and are separated mostly by once to twice their diameters; granules on clypeus finer, middle apical margin nearly smooth and with a few fine punctures; labrum without granules, apical half punctate with fine punctures which are separated by once to twice their diameters. *Pronotum* at broadest point near basal half broader than long (0.925 mm. : 0.825 mm.) and base broader than apex (0.90 mm. : 0.60 mm.). Apical margin when seen from above moderately arcuate and deeply sinuate on each side behind eye before apical angle; apical angles acute and moderately strongly produced forwards and slightly inwards; sides moderately arcuate, scarcely noticeably sinuate before basal angles, somewhat regularly, finely crenate; basal angles nearly rectangular, scarcely

produced; base moderately strongly trisinate, broadly so on each side and very shortly so in front of scutellum. *Pronotum* with the sublateral carinae prominent, slightly converging towards apex, feebly sinuate at apical and basal thirds, complete from base to apical margin, and very broad from basal to apical third. Surface sculptured as follows: a very broad and feebly raised portion extends from base in front of scutellum to base of disk; on each side of this raised portion with a feeble, moderately broad, feebly curved, and oblique impression extending to a broad, moderately feeble, indefinite impression near basal sinuation of sublateral carina; median longitudinal impression beginning at base and ending at about apical one-half, throughout very shallow, broadest at basal two-fifths where it is as broad as scutellum. Surface with the alutaceous microsculpture similar to that of head; disk with the granules slightly coarser than facets of eyes but rather low (*i.e.* not strongly convex) and usually separated by two to three times their diameters, though often, especially on apical portion of disk, more sparsely placed; granules on sides slightly denser but otherwise similar; granules on basal portion of sublateral carina slightly more convex and very slightly denser. *Elytra* more than twice as long as prothorax (1.87 mm.: 0.82 mm.) and very feebly broadened posteriorly to broadest point at apical one-third which is broader than base of pronotum (1.22 mm.: 0.90 mm.). Apices moderately produced, conjointly broadly and feebly rounded. Lateral margins moderately strongly and regularly crenate. Discal surface rather coarsely striate basally, with the striae becoming finer towards apex, and only very feebly impressed beyond apical third; discal strial punctures on basal half nearly subquadrate, deep, about as broad as intervals, and usually separated longitudinally by little more than their own diameters, these strial punctures suddenly becoming nearly obsolete beyond apical half but at sides they are continued further towards apex. Discal intervals flat in apical half and (except sutural) feebly convex on basal half and still more strongly convex at base, with the third interval at base very feebly elevated; surface of intervals, especially at base, alutaceous somewhat similarly to pronotum; set with granules which are similar to pronotal ones but are more convex and on disk become much sparser towards apex; carinate lateral intervals with the granules similar but slightly denser. *Scutellum* flat, subovate, broader than sutural interval (0.10 mm.: 0.087 mm.), longer than broad (0.12 mm.: 0.10 mm.), feebly and broadly rounded at base, and slightly narrowed to apex; surface sculptured similarly to adjacent elytral intervals but with the granules slightly sparser. Beneath with the surface alutaceous as pronotum. Prosternal process as figured (text-fig. 283); middle area of prosternum feebly depressed, slightly rugose, and obscurely granulate similarly to apical portion of pronotal disk; sides more evidently granulate; hypomera sculptured similarly to middle area. Mesosternum with the surface sculptured similarly to middle area of prosternum but more densely granulate. Metasternum feebly depressed posteriorly; with a broad (about 0.025 mm.), deep, median longitudinal impression which ends abruptly at anterior fourth; on each side of middle near base with a broad, shallow, and subtriangular impression; surface of disk with round, rather convex granules which are distinctly coarser than facets of eyes and are usually separated by two times their diameters; side similarly granulate but with the granules slightly less convex. Middle basal portion of first ventral segment moderately depressed, at base rugose and obscurely granulate, and anterior portion with the granules about half as coarse as those of metasternum and usually separated by about five or more times their diameters; basal sides of first and middle

portion of second and third segments similarly granulate; elsewhere on abdomen with the granules separated by two to three times their diameters. Femora and tibiae granulate similarly to abdominal segments; tibiae with no rows of teeth. *Genitalia* as figured (text-figs. 280, 281).

Female: Externally similar to male.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vii. 1934 (*H. E. Hinton*).

Paratypes: 18, with same data as type; 2, collected at the same locality on 15. vi. 1934 (*H. E. Hinton*, *R. L. Usinger*); and 6, MEXICO: Estado de Morelos, Cuernavaca, vi. 1934 (*H. E. Hinton*).

Variations: The scutellum in some specimens is distinctly more narrowly obovate than that of the type. The depth of the pronotal depression near basal sinuation of sublateral carina is slightly greater in some specimens, and the median longitudinal impression of the pronotum appears in some specimens to begin at basal fifth. These variations are, however, scarcely worthy of mention.

Comparative notes: This species can be compared only with *C. heterocerus* (Sharp), which it resembles in general shape, but from which it may be distinguished by the following readily observable characters: (1) the antennae are slightly longer and are entirely rufo-piceous, while in *heterocerus* the apical segments are distinctly darker than the two basal; (2) the elytral intervals are subequally convex at base, the third being only very slightly instead of very much more strongly convex than the other discal intervals; and (3) the basal discal striae punctures are very coarse, being nearly as broad as intervals instead of seldom more than one-third as broad as they are in *heterocerus*.

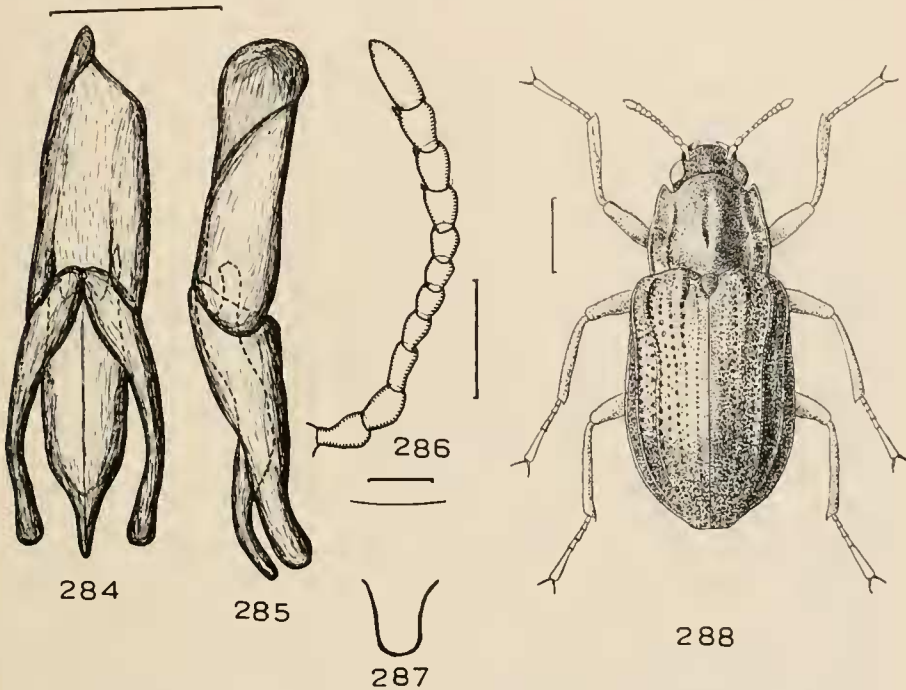
Cylloepus heterocerus (Sharp).

(Text-figs. 284-288.)

1882. *Elmis heterocerus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2): 135, t. 4, fig. 13.

Male: Length, 3.0 mm.; breadth, 1.4 mm. Subparallel, moderately convex. Clothed with fine, moderately short (about 0.05 mm.-0.06 mm. long), moderately recumbent, brownish-testaceous hairs which arise at intervals equal to half or less of their lengths; antennae (probably badly rubbed in specimens before me) with a few fine and short hairs and on inner apex of eighth, ninth, and tenth segments with a prominent brush or erect hairs; labrum clothed as elsewhere but with the lateral apical portions with denser and longer hairs; beneath with the hairs generally shorter. Cuticle moderately shining and for the most part microscopically alutaceous; piceous to feebly rufo-piceous; basal two to five segments of antennae, mouth-parts, and tarsi pale rufo-piceous. Tomentum cinereous with golden reflections. *Head* between eyes with a very feeble and broad impression which ends anteriorly on each side at base of clypeus and extends posteriorly to slightly behind eye on each side and then transversely across head. Antennae as figured (text-fig. 286), with the basal segments always distinctly paler than the apical. Clypeal suture well-marked and nearly straight; clypeus when viewed from in front very broadly and feebly arcuately emarginate; angle on each side obtusely rounded, and sides feebly arcuate. Labrum broadly and feebly rounded in front with the angle on each side broadly rounded. Surface set with round granules which are slightly but distinctly finer than facets of eyes and are usually separated by twice their diameters though often by less; labrum without granules, rather densely alutaceous, and punctate with fine punctures

generally separated by once to twice their diameters. *Pronotum* at broadest point near basal half broader than long (0.98 mm. : 0.90 mm.) and base broader than apex (0.92 mm. : 0.72 mm.). Apical margin as seen from above moderately arcuate at middle and deeply sinuate on each side behind eye before apical angle; apical angles moderately acute, rather broad, and moderately produced forwards and slightly inwards; sides feebly arcuate though slightly more strongly so at basal half, feebly sinuate before basal angles, and scarcely sinuate at apical fourth; lateral margins finely crenate; basal angles feebly acute, nearly rectangular, and scarcely produced; base trisinate, broadly and moderately deeply



TEXT-FIGS. 284-288.—*Cylloepus heteroceris* (Sharp). (284) Dorsal view of male genitalia. (285) Right lateral view of same. (286) Antenna. (287) Prosternum. (288) Adult to show general appearance.

sinuate on each side and shortly and more shallowly sinuate in front of scutellum. *Pronotum* with the sublateral carinae prominent, most strongly raised on basal half, very feebly curving towards apex, moderately strongly sinuate at basal two-fifths, and feebly sinuate at apical one-third and becoming obsolete at about apical eighth; with impressions as follows: a very broad and feebly raised portion extends from near base in front of scutellum to base of disk; median longitudinal navicular impression extending from basal third to apical third, rather deep and well-defined, and broadest at about basal half of pronotum where it is nearly as broad as scutellum; at sides of disk near basal sinuation of sublateral carina with a broad, deep, and slightly oblique impression which when viewed laterally appears to feebly bisect sublateral carina and continue obliquely to apical third of sides near lateral margin where it again becomes as broad as on disk; at sides of disk near apical sinuation of sublateral carina there is a broad, feeble, and transverse impression. Surface sculptured as follows: sides between

sublateral carinae and lateral margins with granules which are round to obovate, coarser than those of head, slightly coarser than facets of eyes, and occasionally confluent but mostly separated by once to twice their diameters; sides of disk near apex with a few feeble granules and also with an occasional granule elsewhere; disk with the punctures fine, shallow, and separated by less than a third to once their diameters so that the surface frequently appears to be eroded. *Elytra* more than twice as long as pronotum (2.25 mm. : 0.90 mm.) and feebly broadened to broadest point which is at apical third and here broader than base of pronotum (1.40 mm. : 0.92 mm.). Apices feebly produced, conjointly broadly and feebly rounded. Lateral margins very feebly crenate. Disk of elytra scarcely noticeably striate on basal portion and beyond apical two-thirds without a trace of striae; discal strial punctures about one-fifth to one-third as coarse as sutural interval, rather shallow, usually round, and separated longitudinally by less than to twice their diameters; at sides between the two carinate intervals and between outer carina and lateral margin with the punctures about half as coarse as sutural interval, subquadrate, deep, and usually separated longitudinally by less than their diameters; these punctures become finer and nearly obsolete at apex. Discal intervals flat, third strongly convex and slightly curved inwards on basal sixth; surface of discal intervals at base granulate similarly to sides of pronotum but with the granules slightly finer; granules on carinae coarser and denser than discal basal ones. *Scutellum* flat, subovate, broader than sutural interval (0.14 mm. : 0.10 mm.), longer than broad (0.17 mm. : 0.14 mm.), feebly and broadly rounded basally, and more narrowly rounded at apex; surface impunctate, without granules, and strongly shining. *Prosternum* with the process shaped as figured (text-fig. 287); middle area of prosternum feebly concave, set with granules which are about as coarse as those at sides of pronotum and which are seldom separated by as much as twice their diameters; hypopleura similarly punctate. *Mesosternum* with the groove for the reception of the prosternal process very deep and broad; surface granulate similarly to prosternum. *Metasternum* very feebly depressed posteriorly; with a broad (about 0.037 mm., posteriorly), deep, median longitudinal line which is much narrowed anteriorly but attains anterior margin; on each side at base with a moderately large oval and shallow impression; surface of disk with the granules similar to those of prosternum but separated by two to four times their diameters; sides with the granules denser, separated by once to twice their diameters. Middle portion of first abdominal sternite feebly depressed; all of middle of first sternite and middle basal portion of second not granulate but finely alutaceous and with a few sparse punctures; sides of ventral segments with finer granules than metasternum, which are usually separated by one to four times their diameters but are even sparser on basal sides of first and second sternites and middle of third and fourth. Femora and tibiae with the feebly obovate granules similar to those of sides of metasternum. *Genitalia* as figured (text-figs. 284, 285).

Female: Externally similar to male.

Type: In the British Museum (Nat. Hist.). GUATEMALA: Vera Paz, San Joaquin (*Champion*).

Specimens examined: 6, with same data as type. 3, MEXICO: Dist. de Temascaltepec, Temascaltepec, alt. 5000-6000 ft., vi. 1934 (*H. E. Hinton*); and one with same data as above but collected on 5. vi. 1933 (*H. E. Hinton, R. L. Usinger*).

Variations: No variations worthy of mention have been observed in the small series before me.

Comparative notes : This species is nearest to *C. blairi*, and for the differences between the two see the description of the latter. It might possibly be mistaken for *C. spinipes* from which it may be distinguished as follows : (1) The antennae are bicolorous instead of unicolorous ; (2) it is a shorter and proportionally broader species ; (3) the pronotal disk is finely and irregularly punctate instead of densely granulate ; (4) the elytral disk is nearly non-striate and moderately finely punctate instead of noticeably striate and coarsely punctate ; and (5) the third discal interval is only convex at base and the others are flat, while in *spinipes* all the discal intervals are moderately convex at base.

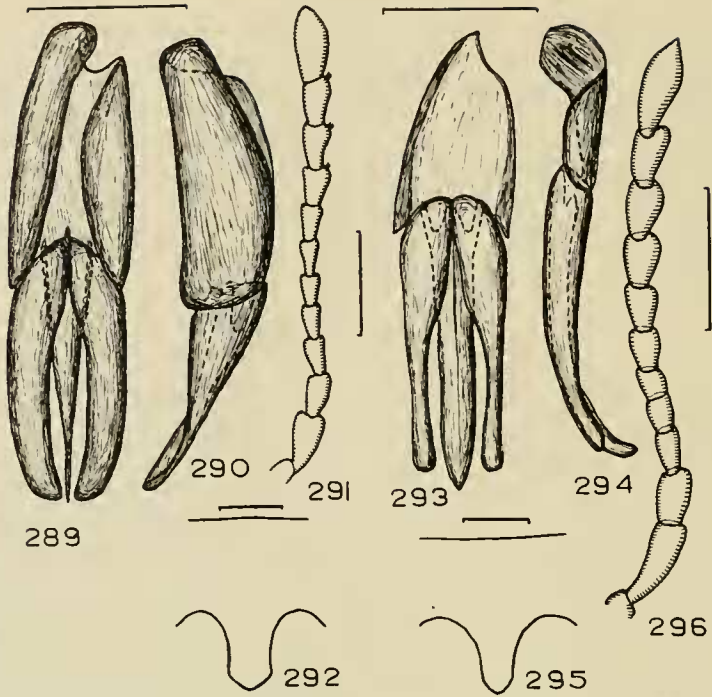
Cylloepus puncticollis (Hinton).

(Text-figs. 251, 297-302.)

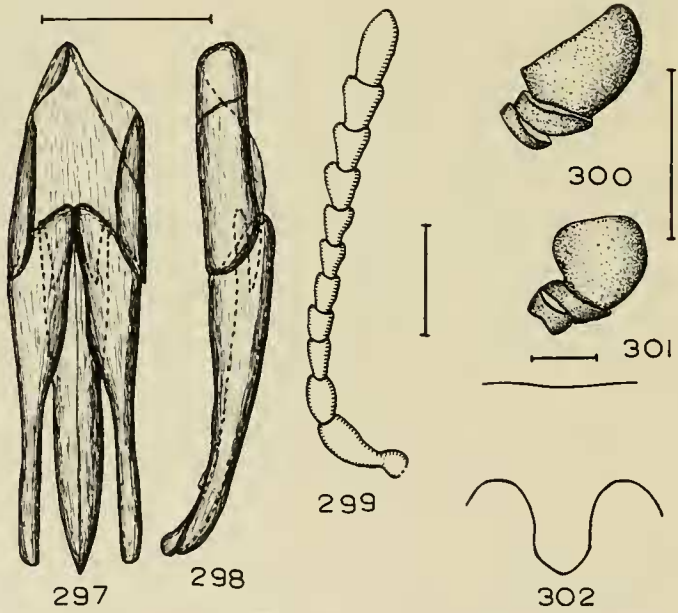
1934. *Stenelmis puncticollis* Hinton, *Rev. Ent., Rio de J.*, 4 : 198.

1937. *Cylloepus puncticollis* Hinton, *Arb. morph. taxon. Ent. Berlin-Dahlem*, 4 (2) : 106.

Male : Length, 2.8 mm.-3.7 mm. ; breadth, 1.1 mm.-1.3 mm. Clothed with fine, short (about 0.037 mm. long), recumbent, brownish-testaceous hairs which arise mostly at intervals equal to distinctly less than their own lengths ; antennae with the apical segments more densely clothed with slightly shorter and more erect hairs ; beneath with the hairs generally shorter ; apical portion of labrum clothed with equally fine but longer (about 0.062 mm.), paler and more erect hairs which are rather dense at sides. Cuticle shining and for the most part alutaceous ; black to dark rufo-piceous ; basal two or more segments of antennae, mouth-parts, legs and surface beneath paler rufo-piceous. Tomentum cinereous with feeble golden reflections. *Head* with a moderately shallow and broad impression extending on each side near eyes to clypeal suture ; on vertex with a moderately deep obovate impression which is nearly as broad as second antennal segment. Antennae (text-fig. 299) bicolorous. Clypeal suture nearly straight, strongly impressed ; anterior margin of clypeus when seen from in front very broadly and feebly arcuately emarginate for its entire breadth, with the angle on each side broadly rounded and the sides feebly arcuate. Labrum with the anterior margin broadly and feebly rounded, with the angle on each side broadly rounded. Surface with the alutaceous microsculpture under a magnification of $\times 150$ appearing densely granulate ; set also with moderately flat granules which are about as coarse as facets of eyes and are usually separated by about once their diameters though at base and sides of head they are slightly sparser ; clypeus similarly granulate ; labrum without granules, finely punctate on a transverse middle band with punctures which are seldom separated by as much as twice their diameters ; extreme apex and base nearly impunctate. *Pronotum* at broadest point which is near basal half slightly broader than long (1.12 mm. : 1.07 mm.) and base broader than apex (1.02 mm. : 0.85 mm.). Apical margin moderately arcuate at middle and deeply sinuate on each side behind eye before apical angle ; apical angles moderately produced forwards and moderately acute ; sides feebly arcuate near basal half, nearly straight on apical half, very feebly sinuate at apical third, and feebly sinuate before basal angles ; lateral margins moderately feebly crenate ; basal angles moderately acute, scarcely produced ; base trisinuate, broadly and moderately strongly sinuate on each side and more narrowly and shallowly sinuate in front of scutellum. *Pronotum* with the sublateral carinae prominent, feebly converging towards apex, moderately feebly sinuate at basal half, and becoming obsolete just before apical



TEXT-FIGS. 289-296.—(289) Dorsal view of male genitalia of *Cylloepus optatus* Sharp. (290) Left lateral view of same. (291) Antenna. (292) Prosternum. (293) Dorsal view of male genitalia of *C. barberi* Hinton. (294) Right lateral view of same. (295) Prosternum. (296) Antenna.



TEXT-FIGS. 297-302.—*Cylloepus puncticollis* (Hinton). (297) Dorsal view of male genitalia. (298) Left lateral view of same. (299) Antenna. (300) Labial palp of male. (301) Labial palp of female. (302) Prosternum.

margin; broadest portion of carina is from basal fourth to apical fourth. Pronotum with impressions as follows: a very broad and gradually widening raised portion extends from base in front of scutellum to base of disk at about apical two-thirds of pronotum; on each side of this raised area a feeble impression extends obliquely forwards from a puncture-like impression near base to join a broad, moderately deep, oblique impression which is mostly on basal third but which narrows and when viewed laterally extends moderately deeply across sublateral carina at the basal impression where the carina is slightly narrowed; median longitudinal impression at base (here occupying most of basal raised area) broad but becoming much narrowed at apical two-thirds, where it suddenly broadens out to a navicular impression which becomes obsolete at about apical sixth, this navicular impression being at its broadest point, which is at apical two-fifths as broad as scutellum. Surface only feebly alutaceous at sides, not alutaceous on disk; disk with round to obovate punctures which vary from being twice the diameter of a facet to being one-fourth this size, though most of them are as coarse as facets of eyes; these punctures are seldom separated by more than their diameters, and near anterior margin the punctures become denser and are often confluent so that here the surface appears to be somewhat rugose; sides of disk near sublateral carinae and bottom of depression near basal sinuation of sublateral carina somewhat rugose; basal lateral portion of disk finely and sparsely punctate; surface of sublateral carinae so densely punctate that it becomes rugose and in certain lights appears to be densely granulate; sides between sublateral carinae and lateral margins slightly more sparsely rugose and granulate. *Elytra* more than twice as long as prothorax (2.40 mm. : 1.07 mm.) and very feebly broadening posteriorly to broadest point which is near apical third and is broader than base of prothorax (1.45 mm. : 1.02 mm.). Apices moderately feebly and broadly produced and conjointly feebly rounded. Lateral margins without distinct crenations. Surface moderately densely striate and discal striae only slightly finer at apical tenth; discal striae punctures round to subquadrate, deep, and at middle of disk from a third to two-thirds as broad as sutural interval and usually separated longitudinally by once to twice their diameters; discal punctures between basal convex intervals usually a little finer and denser; punctures on apical tenth about a fourth as coarse as those on middle of disk. Discal intervals subequal in breadth and with the sutural slightly broader than the others; intervals nearly flat and at basal fifth with all except sutural and fifth feebly convex, third distinctly more convex than second or fourth and fourth slightly more convex than second and posteriorly not as abruptly flattened as others but continued as a feebly convex interval to apical third; surface of intervals feebly alutaceous, on basal fifth with the convex intervals having the granules round, feebly convex, about as coarse as those on sides of pronotum, and seldom separated by more than once their diameters; towards apex the granules of the intervals become much sparser; lateral carinae granulate similarly to basal discal intervals; sutural interval and intervals between striae punctures much more sparsely granulate. *Scutellum* flat, subovate, broader than sutural interval at base (0.12 mm. : 0.10 mm.), longer than broad (0.17 mm. : 0.12 mm.), broadly and feebly rounded basally, nearly truncate, and at apex moderately acutely pointed; surface without distinct granules. *Prosternum* with the process as figured (text-fig. 302); prosternum with the anterior two-thirds (not including process) strongly but not sharply lobed; middle area coarsely but not distinctly rugose and granulate, anterior marginal area and sides not rugose and more finely granulate, and with round, feebly convex granules which are slightly

coarser than facets of eyes and are usually separated by once to twice their diameters; hypomera with the granules finer, very feeble, and not distinct. Mesosternum with the groove for the reception of the prosternal process feebly triangular posteriorly and occupying most of the middle; surface sculptured like the middle of the prosternum. Metasternum very feebly depressed posteriorly and on each side of middle at posterior margin with a large, moderately feeble depression; with a moderately narrow median longitudinal impression which is distinct to anterior two-fifths and becomes obsolete shortly before anterior margin; disk with the usually round granules about half again as coarse as facets of eyes and separated mostly by once to twice their diameters; sides similarly granulate but extreme sides with only an occasional very fine granule. Middle portion of first ventral sternite of abdomen very strongly depressed; lateral carina evident only on basal half and even here very broad and but little raised; anterior border of depression rugose and remainder of surface with the granules from a half to a third as coarse as those of metasternum and separated by three to four times their diameters; sides of first sternite for a short distance near depression granulate nearly as coarsely as metasternum and sides elsewhere as well as those of second and third segments with only an occasional granule; middle portion of sides of four apical sternites with the granules a third to two-thirds as coarse as those of metasternum and separated by one to three times their diameters though slightly finer and sparser on middle region of second, third, and fourth. Femora and tibiae with the granules generally coarser than abdominal ones, about two times as coarse as metasternal ones and similarly separated. First tarsal segment of all legs with two fine and erect hairs at ventral apex. *Genitalia* as figured (text-fig. 297, 298).

Female: Externally similar to male but with the terminal segment of the labial palpi about half as broad as that of male.

Type: ♀ in the British Museum (Nat. Hist.). MEXICO: Tejupilco, Dist. de Temascaltepec, alt. about 4000 ft., vi. 1933 (*H. E. Hinton, R. L. Usinger*).

Specimens examined: 1, with same data as above; and 128, collected in the same locality in vii. 1934 (*H. E. Hinton*).

Variations: In addition to the usual slight variation in the size and density of the punctures and granules on the various sclerites, this species exhibits a moderate range of variation as follows:

- (1) On the pronotum of some specimens there is no definite median longitudinal impression from base to apical three-fourths. There is also a slight amount of variation in the extent and depth of the median navicular impression of the pronotum.
- (2) The punctures of the pronotal disk are in some specimens mostly contiguous to confluent so that the surface appears to be subrugose, while in other specimens the punctures of this area are mostly separated by half their diameters, and the surface never appears to be subrugose.
- (3) A noticeable difference in the shape and breadth of the terminal segment of the labial palpi of both males and females. In the males the thickness of the apex may vary as 1 : 2.
- (4) In a number of specimens the lateral margins of the prosternal process are feebly raised, and occasionally the middle of the process is feebly and longitudinally convex.
- (5) The first ventral abdominal sternite varies from being moderately depressed to being strongly depressed. This variation, except for that in the absolute length of the beetle, is the most noticeable.
- (6) A few specimens have the antennae practically uniformly coloured.

Comparative notes: The punctate instead of granulate pronotal disk will separate this species from *C. spinipes* Hinton. From *C. barberi* Hinton it may be distinguished as follows: (1) the surface of the pronotal carinae is granulate instead of punctate; (2) the basal discal elytral intervals are convex instead of flat; and (3) the depressed instead of flat middle portion of the first abdominal sternite. The moderately convex instead of flat fourth basal interval of elytral disk will serve to distinguish it from *C. optatus* Sharp.

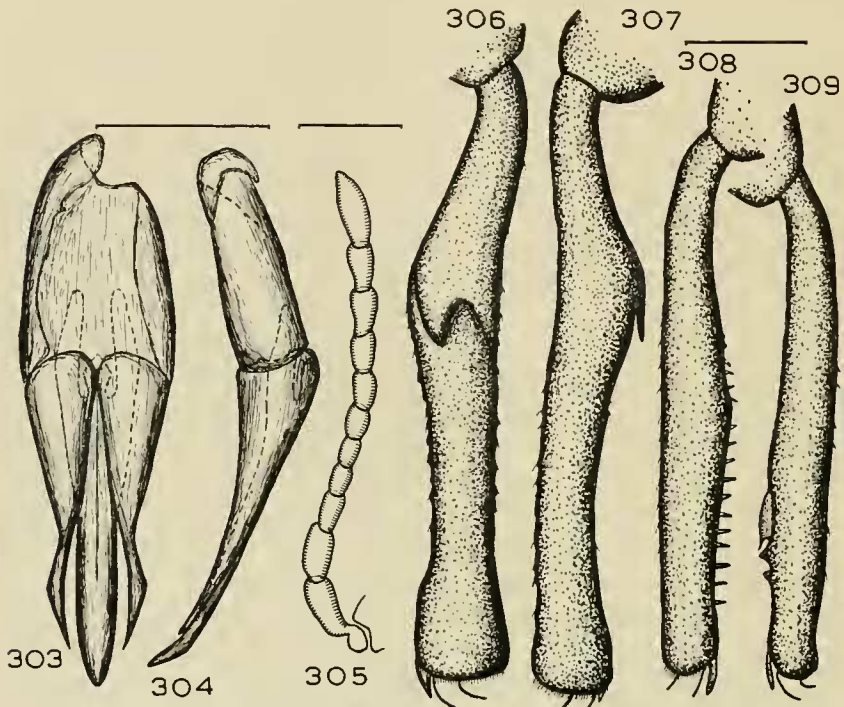
Cylloepus spinipes Hinton.

(Text-figs. 303-309.)

1934. *Cylloepus spinipes* Hinton, *Rev. Ent., Rio de J.*, 4 (2): 192.

Male: Length, 3.0 mm.-3.4 mm.; breadth, 1.1 mm.-1.3 mm. Clothed with fine, short (about 0.038 mm. long), recumbent, brownish-testaceous hairs which arise mostly at intervals equal to slightly less than their lengths; antennae similarly but more sparsely clothed; apical half of labrum clothed with equally fine but much longer (as long as 0.087 mm. at sides) and paler hairs which are more erect and much denser. Cuticle shining and for the most part densely alutaceous; piceous to dark rufo-piceous; antennae, mouth-parts, and legs paler rufo-piceous. Tomentum cinereous with moderate golden reflections. *Head* with a scarcely noticeable, broad, feebly oblique impression which extends shortly on each side near anterior half of eyes. Clypeal suture strongly impressed and feebly arcuate; anterior margin of clypeus very broadly and feebly arcuately emarginate, with the angle on each side obtusely rounded and sides moderately arcuate. Labrum broadly and feebly rounded in front, with the angle on each side broadly rounded. Surface with the alutaceous microsculpture appearing somewhat granulate; with granules which are usually round, slightly coarser than facets of eyes, and usually separated by less than to once their diameters; granules on clypeus similar; labium without granules, apical half punctate with very fine punctures which are usually separated by once to twice their diameters. *Pronotum* at broadest point, which is at basal half, broader than long (1.05 mm.: 0.97 mm.) and base broader than apex (0.96 mm.: 0.72 mm.). Apical margin as seen from above moderately feebly arcuate at middle and deeply sinuate on each side behind eye before apical angle; apical angles acute and strongly produced forwards and very slightly inwards; sides feebly arcuate, more strongly so at basal half, nearly straight at apical fourth and scarcely noticeably sinuate just before basal angles; lateral margins feebly crenate; basal angles feebly acute, nearly rectangular and scarcely produced; base trisinate, broadly and moderately strongly sinuate on each side and shortly and very shallowly sinuate in front of scutellum. *Pronotum* with the sublateral carinae prominent, very slightly converging towards apex, moderately sinuate at basal two-fifths, and extending to apical margin, while the broadest portion of the carinae is from basal fifth to apical fourth. Pronotum also as follows: a very broad and feebly raised portion extends from base to base of disk; on each side of this raised area with a feeble, moderately broad, feebly curved and oblique impression extending to broad, moderately shallow, indefinite impression near sinuation of sublateral carina which when viewed from a nearly lateral position seems to very shallowly extend across sublateral carinae at about middle; median longitudinal impression in some specimens extending from base to basal third as a very shallowly

impressed line and in others beginning only at basal third, but in all extending from basal third to about apical third as a navicular, moderately deep impression which is broadest at middle where it is not quite as broad as scutellum. Surface with the alutaceous microsculpture similar but not as evident as that of head; set with round to feebly obovate granules which are nearly twice as coarse as facets of eyes, low (only feebly convex), and are usually separated by slightly less than their own diameters; granules on sublateral carinae coarser and denser;



TEXT-FIGS. 303-309.—*Cylloepus spinipes* Hinton. (303) Dorsal view of male genitalia. (304) Left lateral view of same. (305) Antenna. (306) Inner view of hind tibia of male. (307) Lateral view of hind tibia of male. (308) Inner lateral view of middle tibia of male. (309) Inner lateral view of front tibia of male.

granules anteriorly on disk slightly finer and sparser. *Elytra* more than twice as long as pronotum (2.30 mm. : 0.97 mm.) and feebly broadening to broadest point, which is at apical third, and is here broader than base of pronotum (1.32 mm. : 0.96 mm.). Apices broadly and moderately feebly produced and conjointly broadly rounded. Lateral margins feebly but regularly crenate. Surface striate with the discal striae moderately coarse at base, becoming finer towards apex, and beyond apical fourth obsolete except for sutural; discal strial punctures round to subquadrate and at basal third a third to two-thirds as broad as intervals, separated longitudinally by once to twice their diameters; these punctures are narrower basally and towards apex rapidly become fine and sparse so that at apical eighth they are about a fourth as coarse as those at basal third. Discal intervals nearly flat and subequal in breadth, at base all except sutural are slightly

convex, and of the convex intervals the third is only slightly more so than the others; surface of intervals at base alutaceous somewhat as pronotum, elsewhere much more sparsely and differently alutaceous; on basal fourth set with granules which are similar in size to those of pronotum and similarly distributed; these granules rapidly become sparser so that beyond basal half the disk is free of granules; granules of carinate intervals equal in size and density to those of elytral base. *Scutellum* flat, subovate, broader than sutural interval (0.14 mm. : 0.10 mm.), longer than broad (0.15 mm. : 0.14 mm.), very feebly and broadly rounded basally, nearly truncate, and at apex narrowly rounded; surface nearly free of granules. *Prosternum* with the process rounded at apex; prosternum and process evenly and moderately depressed, with the anterior two-thirds (not including prosternal process) strongly and abruptly lobed; surface granulate as that of elytral base; hypopleura slightly more sparsely granulate. *Mesosternum* nearly entirely depressed for the reception of the prosternal process; sides near middle coxae very strongly and broadly raised and at apex with a dozen or less slender, long (about 0.075 mm.), erect, brownish-testaceous hairs; surface similar to prosternum but more sparsely granulate. *Metasternum* with nearly the entire discal region occupied by a deep, transverse, oval depression; posterior margin on edge of each side of middle with a moderately deep and large subtriangular impression; with a broad (0.375 mm. broad in specimen 3.0 mm. long) and shallow median longitudinal impression which ends rather abruptly at apical fifth and basal seventh; discal surface granulate similarly to pronotum; sides similarly sculptured but with the granules sparser and extreme sides with the granules very flat. Middle basal portion of first abdominal sternite strongly depressed and sculptured similarly to metasternal disk; ventral sternites elsewhere more sparsely granulate than disk of metasternum and especially sparsely so at middle. Front tibiae with three tooth-like structures as figured (text-fig. 309). Middle tibiae with a ventral row of teeth (text-fig. 308). Hind tibiae with a large, flat, knife-like tooth on inner ventral side at basal two-fifths (text-figs. 306, 307). Surface of femora and tibiae granulate similarly to ventral abdominal segments. *Genitalia* as figured (text-figs. 303, 304).

Female: Externally similar to male except as follows: (1) sides of mesosternum only moderately convex and without the group of long hairs; (2) disk of metasternum not as broadly nor as strongly depressed; and (3) front and hind tibiae without the tooth-like structures and middle tibiae without the row of teeth.

Type: ♂ in the U.S. National Museum. MEXICO: Dist. de Temascaltepec, Real de Arriba, alt. 6000-7000 ft., v-vi-vii, 1933 (H. E. Hinton, R. L. Usinger).

Specimens examined: 68, with same data as type but a few of these also collected at Temascaltepec, alt. about 5000 ft.; 25, as above but collected in vi.vii, 1934 (H. E. Hinton).

Variations: The only notable variation is that in some specimens the median longitudinal line extends from base to basal third as a very shallowly impressed line, while in others it is absent on basal third and only present from basal third to apical third.

Comparative notes: The males may be separated from all other species by the secondary sexual characters of the front and hind tibiae. The females may be distinguished from those of *C. barberi* by the granulate instead of punctate pronotum, while from both *C. puncticollis* and *C. sexualis* they may be distinguished by (1) the strongly instead of feebly depressed metasternal disk and (2) the densely granulate instead of punctate pronotal disk.

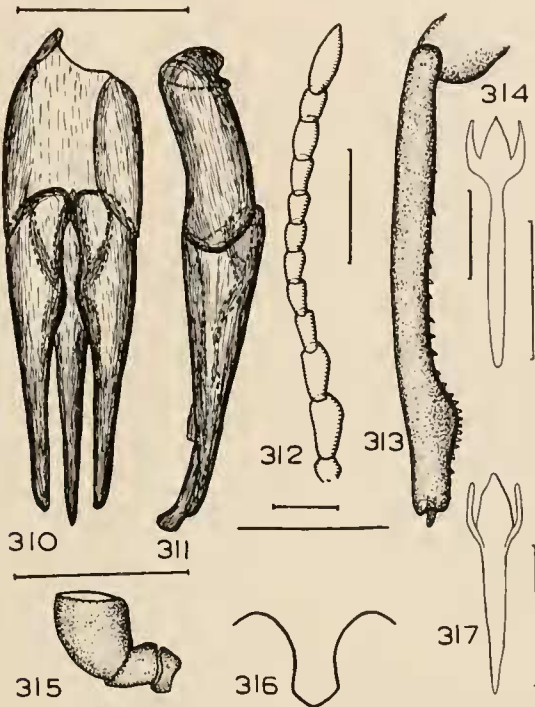
Cylloepus sexualis Hinton.

(Text-figs. 310-316.)

1937. *Cylloepus sexualis* Hinton, *Arb. morph. taxon. Ent. Berlin-Dahlem*, 4 (2) : 102, figs. 4-10.

Male : Length, 3.1 mm.-3.7 mm. ; breadth, 1.2 mm.-1.3 mm. Subparallel moderately convex. Clothed with fine, short (about 0.037 mm. long), recumbent, brownish-testaceous hairs which arise mostly at intervals equal to distinctly less than their own lengths ; antennae with the apical segments more densely clothed with slightly shorter hairs ; labrum clothed with equally fine but generally much longer, more erect hairs which are most numerous at sides. Cuticle shining and for the most part alutaceous ; colour black to dark rufo-piceous ; basal two segments of antennae, mouth-parts, and legs paler rufo-piceous. Tomentum cinereous with golden reflections. *Head* without distinct impressions, but anteriorly between eyes with a median longitudinal impression which is nearly as long as basal segment of antennae and about two-fifths as broad as long. Antennae as figured (text-fig. 312). Clypeus with the suture straight and strongly impressed ; anterior margin of clypeus as usual when seen from in front very broadly and arcuately emarginate, with the angle on each side obtusely and bluntly rounded ; labrum very broadly and feebly rounded in front, with the angle on each side broadly rounded. Surface densely and very minutely alutaceous in such a manner that it appears minutely granulate ; also set with low granules which are about as coarse as facets of eyes and are usually separated by once to twice their diameters though sparser basally where the surface is also somewhat rugose ; granules of clypeus slightly denser and more regularly distributed ; labrum without granules, base and apex nearly impunctate, elsewhere with the punctures fine (about two-thirds as coarse as facets of eyes), round, and usually separated by once their diameters or less. *Pronotum* with the greatest breadth near basal half not as great as length (0.97 mm. : 1.05 mm.) and base broader than apex (0.87 mm. : 0.75 mm.). Apical margin as seen from above moderately arcuate and deeply sinuate on each side behind eye before apical angle ; apical angles moderately produced forwards and moderately acute ; sides moderately arcuate on basal half, nearly straight on apical half, and moderately sinuate before basal angles. Lateral margins finely crenate ; basal angles moderately acute and feebly produced backwards ; base trisinate, broadly and moderately deeply sinuate on each side, narrowly and moderately deeply sinuate in front of scutellum. *Pronotum* with the sublateral carina prominent, moderately feebly converging towards apex, moderately sinuate at basal half, when viewed from above slightly sinuate on apical third, and extending to apical margin ; broadest portion of carina difficult to delimit but apparently extending from basal fourth to apical third. *Pronotum* with the impressions as shown in text-fig. 318 for *C. proximus*. Surface feebly alutaceous, more strongly so at bottom of impressions and at sides and anterior margin but nowhere as strongly alutaceous as head ; disk punctate with round to feebly obovate punctures which are moderately deep, usually a half to two or more times as coarse as facets of eyes, often contiguous or confluent and seldom separated by as much as half of their diameters ; anteriorly on the disk with most of the punctures confluent and therefore appearing rugose ; bottom of the various impressions nearly impunctate and therefore appearing highly polished ; basal convex areas on each side of middle with a few punctures similar to those of disk but slightly sparser ; surface of sublateral carina punctate as on disk but so densely as to appear rugose ; sides near lateral margins much

more sparsely punctate. *Elytra* more than twice as long as pronotum (2.42 mm. : 1.05 mm.) and feebly broadening posteriorly to broadest point which is at apical third and here broader than base of pronotum (1.30 mm. : 0.87 mm.). Lateral margins without distinct crenations. Surface rather coarsely striate, discal striae slightly finer at apical tenth but not obsolete; discal strial punctures subquadrate to nearly round, rather deep, and at middle of disk from two-thirds to as broad as intervals and separated longitudinally by slightly more than to slightly less than their lengths; towards sides the punctures become coarser and



TEXT-FIGS. 310-317.—(310) Dorsal view of male genitalia of *Cylloepus sexualis* Hinton. (311) Left lateral view of same. (312) Antenna. (313) Lateral inner view of front tibia of male. (314) Dorsal view of median lobe of male genitalia. (315) Labial palp of male. (316) Prosternum. (317) Dorsal view of median lobe of male genitalia of *C. proximus* Hinton.

towards apex much finer. Discal intervals (five intervals) all nearly flat, second feebly convex on basal fifth, third strongly convex but becoming flat at about apical three-fourths, fourth flat (with punctures of the two striae almost contiguous so that the fifth seems to be the fourth), and fifth moderately convex on basal seventh; surface of intervals at most only feebly alutaceous; elevated intervals with numerous round and low granules which are slightly coarser than facets of eyes, and the surface here also somewhat rugose; carinate intervals similarly sculptured; surface between punctures with only an occasional granule and often feebly rugose. *Scutellum* flat, ovate, broader than sutural interval at base (0.14 mm. : 0.10 mm.), longer than broad (0.17 mm. : 0.14 mm.), broadly and feebly rounded basally, and at apex moderately acutely rounded; surface with a few coarse and shallow punctures. *Prosternum* with the anterior two-thirds (not including process) strongly but not sharply lobed; prosternal process

as figured (text-fig. 316); surface of middle area densely, moderately coarsely rugose and obscurely granulate, sides with the granules varying much in size but usually about as coarse as facets of eyes or slightly finer and separated by one to three or more times their diameters. Hypomera feebly, moderately sparsely rugose and with a few fine, obscure granules. Mesosternum sculptured similarly to middle area of prosternum. Metasternum with all the middle of the disk except anterior two-fifths moderately strongly depressed but with the area near median line slightly less depressed so that it appears that there are two depressions on disk, one on each side of median line; area just before mesosternum strongly declivous; on each side of middle at posterior margin with a moderately large, oval, deep depression; with a broad (0.037 mm. basally), deep, median longitudinal impression which extends broadly to apical third; surface of disk granulate with round to obovate, flat-topped granules which are as coarse as facets of eyes and are separated by once to twice their diameters; sides similarly granulate but extreme sides and pleura with only a few fine and obscure granules. First abdominal sternite with the entire middle portion strongly depressed and posteriorly at middle this depression seems to encroach upon middle of second segment as far as apical two-fifths; surface of the depression feebly rugose; carinae of first sternite prominent and extending from base to apex; surface of sides of first sternite and extreme sides of others with only an occasional granule; surface of segments elsewhere with rather flat, round granules which are half as coarse as facets of eyes and are usually separated by two to three times their diameters. Hind coxa with a moderately large and deep, usually oval depression. Femora and tibiae very finely but otherwise similarly granulate to metasternal disk; the front tibia on inner apex has a toothed carina (text-fig. 313); inner ventral side of middle tibiae with a row of teeth similar to that of front tibiae; hind tibiae with no rows of prominent teeth; when viewed from inner dorsal side feebly curved and moderately swollen at apical two-fifths for a short distance; when viewed ventrally this swollen portion is somewhat concave and the tomentum is here particularly long and dense. *Genitalia* as figured (text-figs. 310, 311).

Female: Differs externally from male as follows: (1) the basal abdominal depression does not encroach on to second sternite so that there is no trace of a depression here; (2) the front tibia has no carina or teeth as has been figured for the male; (3) the middle tibia has no row of teeth; and (4) the hind tibia though nearly as curved at apical two-fifths as in male is not as thick.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vii. 1934 (*H. E. Hinton*).

Specimens examined: 80, with same data as above; 16, with same data but collected 15-28. vi. 1933 (*H. E. Hinton, R. L. Usinger*); 1, Dist. de Temascaltepec, Temascaltepec, alt. about 5000 ft. (*H. E. Hinton, R. L. Usinger*).

Variations: Besides slight variations in body size and density of granules the following have been noted: (1) a noticeable variation in the depth of the depression which parallels basal raised portion of pronotum at the point where it joins the large impression near basal situation of sublater lateral carina, being sometimes absent at this point so that basal convex portion appears as part of the disk; and (2) a slightly noticeable difference in the proportions of length to breadth of the prothorax.

Teratology: One female specimen is malformed as follows: the outer sublateral carina (on eighth interval) is broadly interrupted on the left side at apical two-fifths and less broadly interrupted on the right side at the same place, and the inner sublateral carina is broadly interrupted at basal third on left side only.

Comparative notes: The punctate instead of granulate pronotal disk will serve to distinguish it from *C. spinipes*. The bicoloured instead of uniformly coloured antennae, the coarsely and densely instead of finely and moderately sparsely punctate pronotal disk, the strongly convex instead of nearly flat third basal interval of elytra, and the strongly depressed instead of nearly flat middle of basal abdominal sternite will separate it from *C. barberi*. From *C. optatus*, to which it is most closely related, it may be distinguished as follows:

C. sexualis.

1. Antennae with the two basal segments pale rufo-piceous and the others piceous to black.
2. Elytra with the fifth interval at base moderately strongly convex.
3. Male with the second abdominal sternite depressed only at middle of basal half.
4. Male with a short, prominent carina-like swelling at inner apical fourth of front tibia.
5. Front tarsi of males without numerous erect hairs on ventral surface

C. optatus.

1. Antennae uniformly pale rufo-piceous; sometimes with the two basal segments slightly paler.
2. Elytra with the fifth interval at base at most feebly convex.
3. Male with the second abdominal sternite depressed at middle of basal two-thirds.
4. Male without a carina on front tibia.
5. Males with the four basal segments of the front tarsi densely clothed on ventral side with moderately long, erect, pale-testaceous hairs.

C. sexualis superficially resembles *C. puncticollis* but may at once be separated by the flat fourth and convex fifth, instead of flat fifth and convex fourth basal discal elytral intervals. The terminal segment of the labial palp is normal in the males of *C. sexualis*, while in those of *C. puncticollis* it is very much broadened at apex.

***Cylloepus proximus* Hinton.**

(Text-figs. 317, 318.)

1937. *Cylloepus proximus* Hinton, *Arb. morph. taxon. Ent. Berlin-Dahlem*, 4 (2): 106, figs. 11, 12.

Male: Length, 3.3 mm.; breadth, 1.28 mm. Similar to male of *sexualis* except as follows: *Elytra* with the fifth interval very shortly and scarcely noticeably elevated, while that of *sexualis* is distinctly elevated for a short distance. *Abdomen* with the depression of the first sternite not, or just barely, encroaching on second sternite. Inner apex of front tibia without a toothed ridge, as is the case in *sexualis*; hind tibia with the apical half not as strongly curved or swollen as that of *sexualis*. *Male genitalia* of both species very similar, the chief differences being found in the median lobes which have been dissected out and illustrated (*sexualis*, text-fig. 314; *proximus*, text-fig. 317).

Type: ♂ in the Deutsches Entomologisches Institut, Berlin-Dahlem. MEXICO: Puebla, Necaxa (*Georg Heine*).

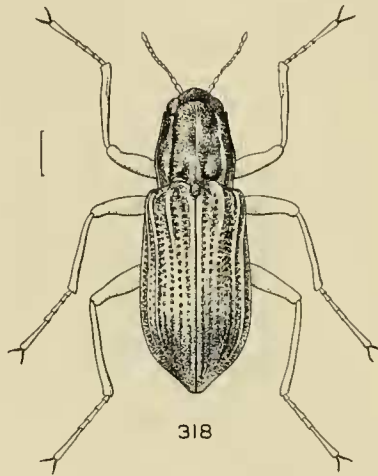
LARVAE.

The larvae of *Cylloepus* have been determined by elimination and locality. Only one Mexican species is available, and it appears to be either *C. puncticollis* (Hinton) or *C. sexualis* Hinton. The larva of a species (*C. consobrinus* Grouvelle?)

from the Yungas Valley of Bolivia is also available. The following generic characterization is drawn from a study of these two species.

Generic Characters of Larvae of Cylloepus.

Cylindrical, parallel. *Head* when viewed from above exposed and not concealed by the pronotum. With one ocellus on each side. Antennae 3-segmented, feebly retractile. Clypeus with the suture distinct. Mandibles of both sides similar and with three acute apical teeth; protheca long, slender, and densely spinose. Maxilla with the palp 4-segmented and the stipes showing no differentiation into a palpifer; galea and lacinia separate and apex of each densely spinose. Labium with the postmentum undivided; palp 2-segmented and prementum without a palpiger. Gula well developed. *Prothoracic pleurae* not



TEXT-FIG. 318.—*Cylloepus proximus* Hinton.

divided, meeting on middle line of body. Meso- and metathoracic pleurae with only the sterno-pleural suture present. First abdominal segment with only the sterno-pleural suture present; second to eighth with discrete pleurae bounded by tergo- and sterno-pleural sutures and these sutures are continued to basal half of ninth segment; these sutures do not converge where they terminate, as in most Elmidae, but remain parallel. Anterior and posterior part of prosternum divided by a complete median longitudinal suture. Ninth abdominal segment with the apex broadly and strongly emarginate; operculum with two strongly sclerotized claws attached to dorsal membrane. Spiracles annular and biforous, present on antero-lateral part of mesothorax and first eight abdominal segments, and opening at level of cuticle and not on well-developed tubercles; tracheae without air sacs; with three tufts of retractile, anal, tracheal gills. *Alimentary canal* with a small dorsal oesophageal sclerite on posterior margin of oesophagus. Hind gut with six Malpighian tubules. *Central nervous system* with three thoracic and eight abdominal discrete ganglia. Stomodaeal nervous system with two occipital ganglia and a single oesophageal ganglion.

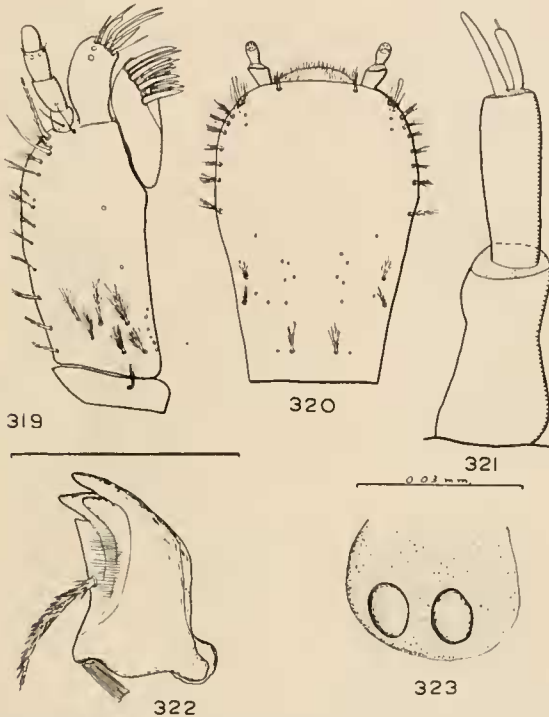
In general appearance the larvae of this genus are very similar to those of *Stenelmis* Dufour, but they may at once be distinguished from *Stenelmis* and all

other known genera by the complete absence of tergo-pleural thoracic sutures and the presence of both tergo- and sterno-pleural sutures on the ninth segment.

Description of Mature Larva of Cylloepus sp.

(Text-figs. 319-329.)

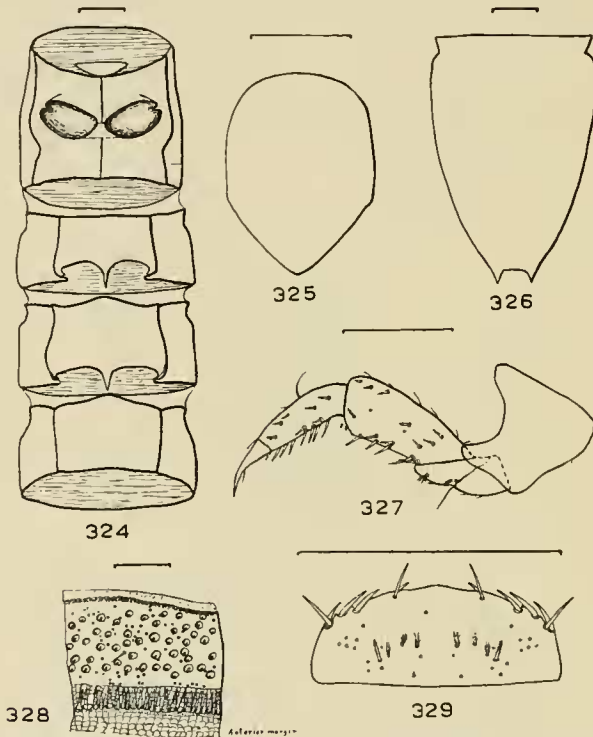
Length, 8.0 mm. ; breadth (across broadest point which is near base of meta-thorax), 0.70 mm. Cuticle brownish-testaceous to brown. *Head* rectangular, slightly broader than long (0.52 mm. : 0.50 mm.). Epicranial suture nearly



TEXT-FIGS 319-323.—Larva of *Cylloepus* sp. (319) Ventral view of right maxilla. (320) Ventral view of labium. Setae of prementum are only approximately correct. (321) Antenna. (322) Mandible. (323) Mesothoracic spiracle.

straight and 0.07 mm. long ; frontal suture extending nearly in a straight curve on each side to margin of head opposite base of antenna. Cuticle on a basal belt which is nearly as long as epicranial suture finely and transversely alutaceous ; elsewhere with round punctures which are about 0.02 mm. broad and are separated by less than to nearly three times their diameters ; from these punctures arise fine setae which are usually only slightly longer than the breadth of their respective punctures though occasionally they are about five times this length. Antenna as figured (text-fig. 321) ; retractile to basal third of first segment. Frontal margin of head with a tooth-like projection on each side of clypeus between clypeus and base of antenna which is two-thirds as long as basal segment of antenna. Clypeus with the fronto-clypeal suture distinct ; slightly longer and broader than labrum ; and with the anterior margin truncate, with the angle on

each side rounded. Labrum (text-fig. 329) with the epipharynx smooth. Mandibles, maxillae and labium as figured (text-figs. 322, 319, and 320). *Thorax* and first abdominal segment with the proportions as figured (text-fig. 324). Surface of thorax and abdomen for the most part punctate as frontal region of head but with the punctures about a third larger; posterior margin of each segment except ninth with a dense and complete ring of tubercles (text-fig. 328) near anterior margin of each segment with a dense and complete ring of tubercles



TEXT-FIGS. 324-329.—Larva of *Cylloepus* sp. (324) Ventral view of thorax and first abdominal segment to show sclerotization. (325) Operculum. (326) Dorsal view of ninth abdominal segment. (327) Posterior view of left front leg. (328) A section of third abdominal tergite. (329) Dorsal view of labrum.

from which long flat setae arise (text-fig. 328). *Legs* all fairly close in size and chaetotaxy to front leg (text-fig. 327).

Specimens examined: 2, apparently mature larvae taken in a small (5-30 ft. across) and rapid flowing stream. MEXICO: Dist. de Temascaltepec, Tejupilco, alt. about 4000 ft., vii. 1934 (*H. E. Hinton*).

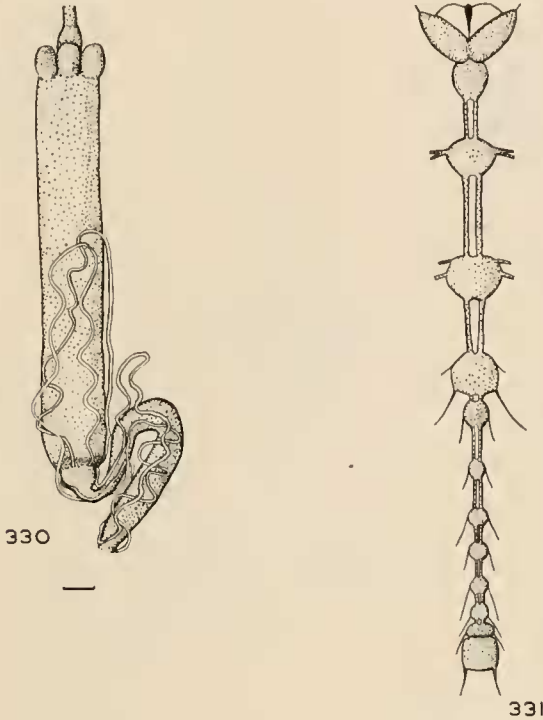
HETERELMIS Sharp.

1882. *Heterelmis* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2): 130.

At the time of writing 10 species and 1 subspecies of this genus have been described. To these two new species and one new subspecies are added in this paper. The species occur from southern United States to south Brazil, and are

also known from Trinidad and Tobago in the British West Indies. A redescription of the genus follows:

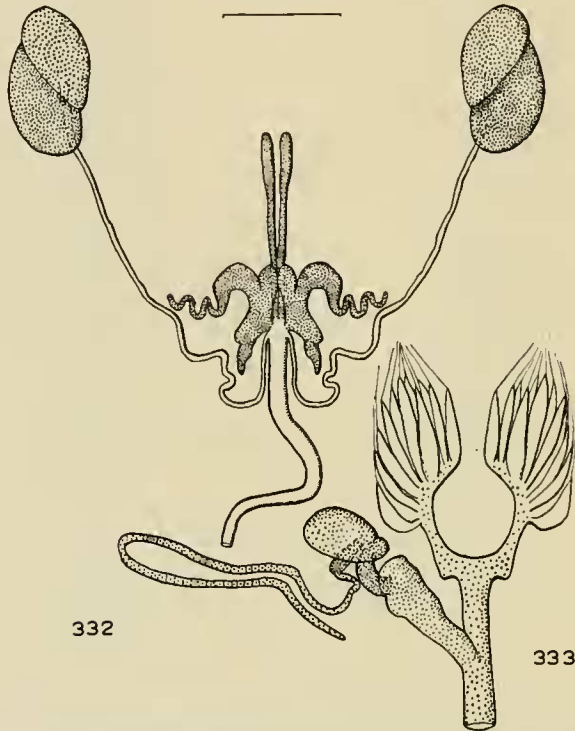
Body subovate to subparallel. Non-tomentose areas glabrous or clothed with sparse and short recumbent to suberect hairs. Scale-like or hairy tomentum confined to the following areas: (1) genae; (2) epipleura; (3) hypomera from posterior fourth to anterior half with a ventral belt which at broadest is two-fifths of hypomera, and this belt extends to anterior margin as a narrow fringe along sterno-notal suture; (4) sides of prosternum, mesosternum, and abdominal sternites; and (5) part or all of legs except tarsi. *Head* when seen from below



TEXT-FIGS. 330, 331.—*Heterelmis longior* (Grouvelle). (330) Alimentary canal. (331) Dorsal view of central nervous system.

capable of being retracted so that none of the mouth-parts are visible. Antenna (text-fig. 337) 11-segmented. Mandibles (text-fig. 335) with three subacute apical teeth; prostheca long and entirely membranous with numerous long spines and hairs apically. Maxilla (text-fig. 334) with the palp 4-segmented and the stipes with a well-developed palpifer; galea and lacinia separate and apex of each densely spinose or hairy. Labium with the palp (text-fig. 365) 3-segmented and prementum without a distinct palpifer. Mentum as broad and three-fourths as long as submentum. Gula about a fifth longer than submentum, at anterior margin about three-fourths as broad as submentum, and with the sides feebly converging so that at posterior margin it is only half as broad as submentum. *Pronotum* with the anterior margin moderately arcuate at middle and on each side behind eye before apical angle broadly and moderately deeply sinuate. Base trisinate, broadly and moderately deeply so on each side and more narrowly

and shallowly so in front of scutellum. Pronotum on each side with a sublateral carina which extends from base to, or very nearly to, anterior margin; without or with a transverse impression at middle; with or without a median longitudinal discal impression; and with or without an oblique impression on each side on basal half. *Elytra* punctate and striate; each elytron with a longitudinal carina on sixth interval and one on eighth. Hind wing (text-fig. 341) without an anal lobe; without a radial cross vein or an anal cell; first anal absent; second anal with the first and second branches present; third anal without a second branch; fourth anal well-developed; and cubito-anal cross



TEXT-FIGS. 332, 333.—*Heterelmis longior* (Grouvelle). (332) Male reproductive system. (333) Female reproductive system.

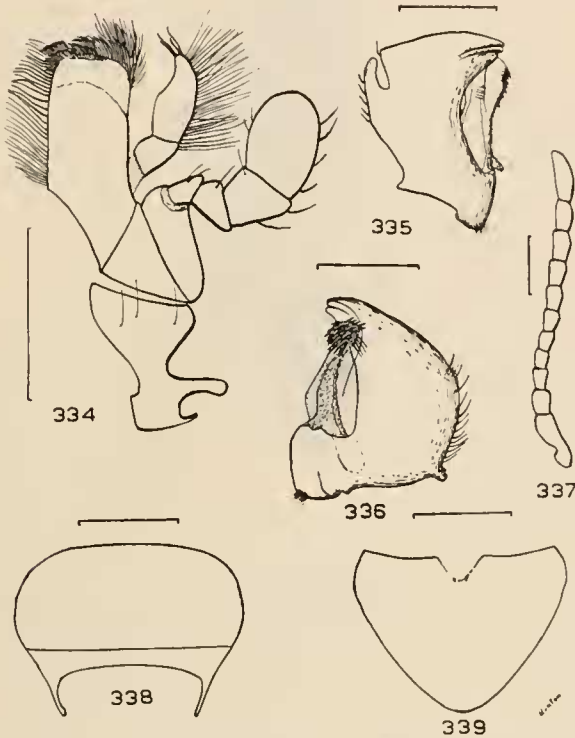
vein complete and joining cubitus to second anal. *Prosternum* very long in front of anterior coxae; prosternal process long, very broad, and with the posterior margin broadly rounded to nearly truncate. *Mesosternum* with a moderately deep and very broad groove for the reception of the prosternal process. *Metasternum* with a median longitudinal impressed line. *Legs* with the visible portion of the front coxae rounded and trochantin completely concealed by the hypomera and sternum. Claws without teeth. *Alimentary canal* (text-fig. 330) with six caeca on the anterior margin of the mid-gut. Hind gut with six Malpighian tubules which end freely near the rectum. *Male reproductive system* (text-fig. 332) with the lateral accessory glands lobed. Each testis with two sperm tubes. *Female reproductive system* (text-fig. 333) with 11 egg tubes to each ovary. Spermathecal duct opening into apex of bursa copulatrix. *Central nervous*

system (text-fig. 331) with three thoracic discrete ganglia; abdominal ganglia one to six discrete and seven and eight only partly fused together.

GENOTYPE: *Heterelmis obscura* Sharp (1882).

The internal anatomy of three species has been examined and found to agree in essential details, and that of *H. longior* (Grouvelle) (*Elmis*) is figured.

This genus is close to no other so far described, and the fact that it is isolated is also borne out by the structure of the larvae (*vide infra*). Occasionally the smaller species superficially resemble members of the genus *Hexacylloepus*

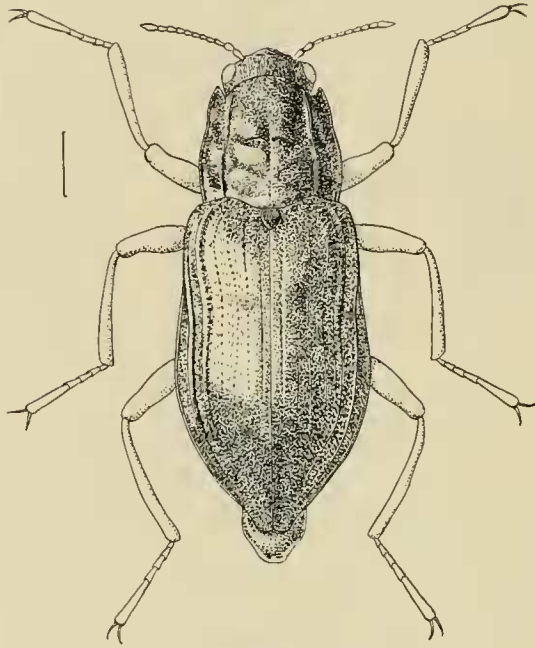


TEXT-FIGS. 334-339.—*Heterelmis longula* Sharp. (334) Maxilla. (335) Dorsal view of left mandible. (336) Ventral view of same. (337) Antenna. (338) Outline of labrum. (339) Outline of apical abdominal tergite.

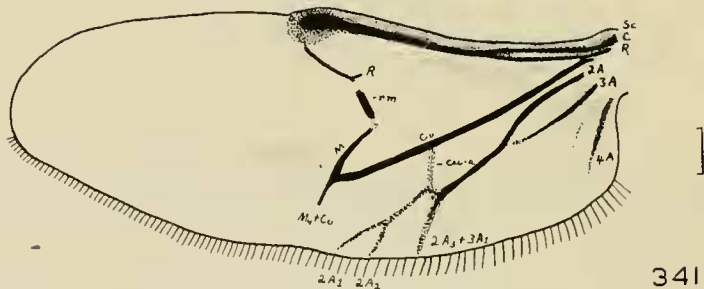
Hinton, but may be distinguished from this genus as follows: (1) the hypomeron always has adjacent to sterno-notal suture a narrow belt of tomentum which extends to anterior margin and there is never a complete transverse belt, whereas in *Hexacylloepus* there is no anterior belt of tomentum adjacent to the sterno-notal suture, and there is at about the middle a complete transverse belt; (2) the hind wing has the second branch of the third anal absent whereas in *Hexacylloepus* it is present; (3) the hind gut has six instead of only four Malpighian tubules; (4) the lateral accessory glands of the male reproductive system are lobed, whereas in *Hexacylloepus* they are not lobed; (5) each ovary has 11 egg tubes instead of only seven; and (6) the central nervous system has the first six abdominal ganglia discrete, whereas in *Hexacylloepus* the first is partly fused to the third thoracic and only two to five are discrete.

The most important characters for distinguishing the various species seem to be the following :

- (1) General proportions, length and breadth.
- (2) Colour.



340



341

TEXT-FIGS. 340, 341.—*Heterelmis longula* Sharp. (340) Adult to show general appearance. (341) Hind wing. Venation after Forbes.

- (3) Size and distribution of the punctures and tubercles on the various sclerites, and density and type of microsculpture, if present, between tubercles and punctures.
- (4) Condition of fronto-clypeal suture.
- (5) Condition of the anterior margin of clypeus and labrum, and also the condition of the angle on each side.
- (6) Outline of pronotum and its general proportions.
- (7) Extent and depth of pronotal impressions.

- (8) Shape of elytral apices.
- (9) Shape of scutellum.
- (10) Shape and extent of prosternal carinae.
- (11) Breadth of prosternal process and shape of posterior margin.
- (12) Extent and depth of the various impressions on disk of metasternum.
- (13) Length and shape of carinae of first abdominal sternite.
- (14) Secondary sexual characters.
- (15) Structure of the male genitalia.

Only one of the species before me has secondary sexual characters, and since only a male has been found, it is entirely by analogy with other genera that the following are considered to be secondary sexual characters :

- (1) Male with the disk of the metasternum strongly concave (*tarsalis*).
- (2) Male with a large oval area of dense, recumbent, testaceous hairs on inner side of posterior gibbosity of metasternal disk (*tarsalis*).
- (3) Male with the apex of front tibiae moderately gibbous (*tarsalis*).
- (4) Male with numerous pale, erect hairs on ventral surface of four basal segments of front and middle tarsi (*tarsalis*).

A KEY TO THE MEXICAN SPECIES OF *Heterelmis*.

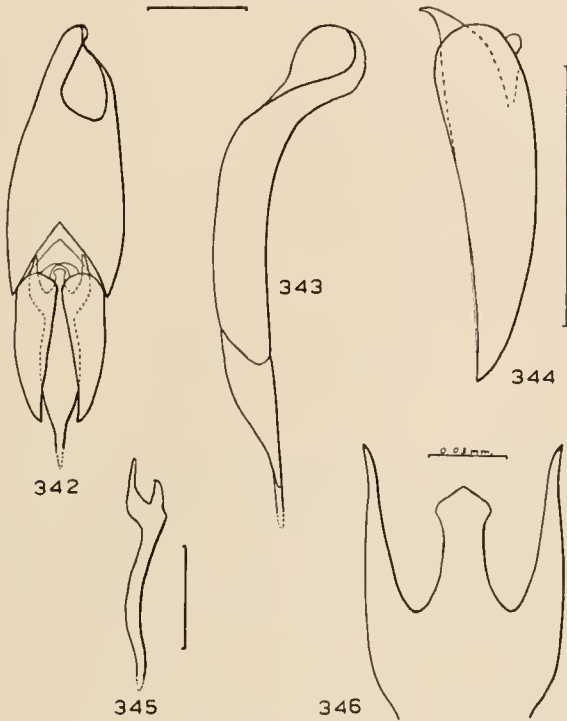
1. Metasternal disk strongly, longitudinally concave for its entire length ; tibiae of front legs clavate ; basal four segments of front and middle tarsi of male with a conspicuous fringe of erect hairs ; male genitalia with the median basal projection of median lobe triangularly broadened. MEXICO *H. tarsalis*, sp. n.
- Metasternal disk only feebly concave posteriorly ; tibiae of front legs not clavate at apex ; basal four segments of front and middle tarsi of male without a conspicuous ventral fringe of erect hairs ; male with the median basal projection of median lobe aciculate, not triangularly broadened 2.
2. Basal segment of all tarsi with two close, stout, short spines on inner apex ; parameres of male genitalia without an inner apical fringe of hairs, though (when stained carefully) with an occasional very minute hair 3.
- Basal segment of tarsi without two stout spines on inner apex ; parameres of male genitalia with an inner apical fringe of moderately long hairs 5.
3. Length of prothorax nearly always more than 0.925 mm. ; median lobe of male genitalia with the basal median projection seen from the side gradually sloping behind. MEXICO *H. longula* Sharp (1887).
- Length of prothorax nearly always less than 0.925 mm. ; median lobe of male genitalia when seen from the side strongly declivous behind 4.
4. Pronotum with the disk not evenly convex, *i.e.* with impressions. MEXICO, GUATEMALA *H. obesa* Sharp (1882).
- Pronotum with the disk evenly convex. MEXICO *H. obesa plana*, subsp. n.
5. Median lobe of male genitalia broad, opposite apices of parameres it is 0.050 mm. broad. TEXAS, MEXICO, GUATEMALA, COSTA RICA, PANAMA, BRAZIL *H. obscura* Sharp (1882).
- Median lobe of male genitalia narrow ; opposite apices of parameres it is 0.170 mm. broad (it has not been possible to separate females of *obscura* from those of *acicula*). MEXICO *H. acicula*, sp. n.

Heterelmis tarsalis, sp. n.

(Text-figs. 342-346.)

Male: Length, 2.2 mm.; breadth, 1.02 mm. Obovate. Surface pubescent as usual in the genus; hairs on dorsal surface usually brownish-piceous. Cuticle moderately shining and black; antennae, mouth-parts and legs rufo-piceous. *Head* without distinct impressions; surface minutely, densely eroded and also with the surface of the callosities punctate with fine (about 0.007 mm. broad) punctures which are about half as coarse as facets of eyes and are separated by less than to two or three times their diameters. Clypeus with the fronto-clypeal suture moderately deep and nearly straight; anterior margin feebly, arcuately emarginate for its entire breadth, and with the angle on each side broadly rounded; surface more coarsely and sparsely eroded (or rugulose) than head; the punctures are larger and seldom appear to be on callosities. Labrum with the anterior margin broadly, feebly arcuate and with the angle on each side broadly rounded; surface not eroded, minutely alutaceous, and with punctures which are finer than those of head and slightly sparser. *Pronotum* at broadest point, which is at basal third, broader than long (0.875 mm. : 0.660 mm.) and base broader than apex (0.825 mm. : 0.500 mm.). Sides moderately strongly arcuate at basal third, elsewhere more feebly arcuate but at middle opposite median transverse impression they are feebly sinuate. Median transverse impression broad, moderately strongly impressed, and distinct to sublateral carinae; at middle this impression is crossed by a deep, oval impression which is about 0.075 mm. broad and 0.125 mm. long. Oblique impression begins on middle fourth of basal third of pronotum, is broader and not as deep as transverse impression, nearly meets transverse impression at sublateral carinae, and extends obliquely forwards to meet lateral margin at basal two-fifths. Base on each side of scutellum with a moderately deep, oval impression which is only a little smaller than median discal impression. Surface of pronotum between sublateral carinae with two sizes of punctures as follows; coarse punctures, which are about as large as facets of eyes or occasionally slightly larger, are contiguous to separated by as much as five times their diameters; fine punctures usually about a fourth to a third as coarse and separated by five or more times their diameters (as on apical discal region), though often (as on apical sides) coalescing to form a densely and minutely eroded area; there are also numerous intergradations between these two sizes of punctures. Sides of pronotum between sublateral carinae and lateral margins minutely, densely eroded, and also with round granules which are usually about a third coarser than facets of eyes and are mostly separated by once to twice their diameters. *Elytra* twice as long as pronotum (1.3 mm. : 0.660 mm.) and broadest point is at about apical two-fifths. Striae very feebly impressed, slightly more strongly impressed at sides and apex; strial punctures deep and usually round, on discal region from a fourth to more than a third as coarse as discal intervals and separated longitudinally by once to twice their diameters. Second and third intervals slightly broader than sutural; surface of intervals on a narrow basal belt and laterally beyond inner carinae with occasional granules similar to those of sides of pronotum; surface elsewhere with the punctures from which the hairs arise as fine as finest of pronotum and separated by two to ten times their diameters. *Scutellum* subovate and with only fine punctures similar to those of elytral intervals. *Prosternum* which is unusually broad for this genus has the ratio of breadth (at broadest point which is at basal fourth) to length

0.350 mm. : 0.200 mm. ; the apical margin is broadly truncate with the angle on each side broadly rounded ; the sides are reflexed upwards at an angle of about 30° with the result that the prosternal process appears strongly concave ; on each side from base of process the fine, straight, *i.e.* not oblique, carina extends to apical third of prosternum. Metasternum with the disk strongly concave and sloping downwards anteriorly, and at the bottom of this cavity with a fine, median longitudinal line which extends from posterior margin to anterior fifth ; on each side near posterior margin the disk is strongly and broadly gibbous, and



TEXT-FIGS. 342-346.—*Heterelmis tarsatus* Hinton. (342) Dorsal view of male genitalia. (343) Right lateral view of same. (344) Dorsal view of paramere. (345) Lateral view of median lobe. (346) Dorsal view of base of median lobe.

on the mesal side of each gibbosity is a large, oval patch of testaceous hairs which are as coarse and half again to twice as long as discal hairs ; surface of disk at middle with punctures which are but slightly coarser than those of elytral intervals and are separated by two to five times their diameters ; at sides of disk and on sides of metasternum the surface is often finely and densely eroded and also set with punctures which are slightly coarser than coarse ones of disk of pronotum but are similarly distributed ; extreme sides also with fine granules which are slightly finer than coarse punctures. Abdominal sternites on middle between tomentose portions with punctures a little coarser (base of basal segment with punctures as much as a third coarser) than discal pronotal ones and separated by less than to three times their diameters. *Legs* with the front tibiae gradually becoming stouter towards apex so that at broadest point, near apical fifth, they are 0.100 mm. in diameter. Ventral surface of basal four segments of front

tarsi with about 25 erect hairs which are slightly longer than apical diameter (or occasionally shorter) of the second segment. Ventral surface of basal four segments of middle tarsi have about 60 erect hairs which are slightly longer than apical diameter of second segment. Ventral surface of four basal segments of hind tarsi with an occasional erect hair. *Genitalia* as figured (text-figs. 342-346).

Female: Unknown.

Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Tejupilco, alt. 3500 ft., vii. 1934 (*H. E. Hinton*).

Comparative notes: This is one of the most aberrant species of the genus. It may be distinguished from all other described species of *Heterelmis* by the following: (1) the straight instead of oblique prosternal carinae; (2) the unusually broad and short prosternal process; (3) the longitudinally concave disk of the metasternum which slopes downwards towards anterior margin; (4) the broadly and strongly gibbous region on each side of posterior part of metasternal disk; (5) the dense patch of testaceous hairs on mesal side of each discal gibbosity; (6) the clavate front tibiae; (7) the fringe of erect hairs on the ventral surface of the four basal segments of all tarsi; and (8) the structure of the male genitalia. It seems probable that of these characters only the first two will be possessed by the female, the others probably being secondary sexual characters.

***Heterelmis longula* Sharp.**

(Text-figs. 334-341.)

1887. *Heterelmis longulus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2): 775.

Male: Length, 3.5 mm.-4.0 mm.; breadth, 1.2 mm.-1.6 mm. Elongate, subparallel. Dorsal surface clothed with fine, recumbent to suberect, testaceous setae which are usually about 0.075 mm. long and arise from minute punctures which are separated by distances equal to or slightly less than the lengths of the hairs; on elytra these hairs are mainly confined to the surface of the intervals so that in specimens which have not been rubbed they appear to be arranged in longitudinal rows. Ventral surface—apart from tomentose areas—clothed with finer, sparser, and generally slightly longer hairs. Cuticle moderately to strongly shining and black to dark rufo-piceous; antennae, mouth-parts, legs and often middle portion of ventral surface paler rufo-piceous. *Head* without distinct impressions; surface minutely and densely eroded and punctate as follows: throughout with numerous microscopic (about 0.005 mm. broad) punctures; and also with larger (0.020 mm. broad) punctures which are on the small, irregular, flat callosities and are separated by much less than to twice their diameters. Clypeus with the fronto-clypeal suture deeply impressed and nearly straight; anterior margin scarcely noticeably, arcuately emarginate for its entire breadth, and with the angle on each side broadly rounded; surface at sides sculptured similarly to head but on middle region not distinctly eroded and with the punctures slightly coarser and never on callosities. Labrum as figured (text-fig. 338); surface punctate more finely but otherwise similarly to middle region of clypeus; basal region very finely, transversely alutaceous and without coarse punctures. *Pronotum* (for dimensions see Table VIII) with the greatest breadth at about basal third. Sides moderately strongly arcuate at basal third, elsewhere only feebly arcuate; feebly and broadly sinuate at middle half opposite transverse impression. Transverse impression at middle broad, moderately strongly impressed and distinct to sides; at middle bisected by a deep, oval impression

which is (in a specimen 3.60 mm. long) 0.100 mm. broad and 0.125 mm. long; near middle third on basal third of pronotum an oblique impression extends on each side so as nearly to join transverse impression at sublateral carinae, this oblique impression being half again as broad and equally as strongly impressed as the transverse impression. Near base on each side of scutellum in front with an oval feebly impressed area about two-thirds as large as median oval impression. Surface punctate as middle of clypeus, the punctures being of various sizes so that the smallest are no more than a fourth as large as the largest and are usually round but often irregular, and are confluent to separated by about (on apical discal portion) twice their diameters; sides between sublateral carinae and lateral margins slightly more coarsely but otherwise similarly sculptured to middle region of head though often with round granules which are a little larger than punctures. *Elytra* longer than pronotum (ratio usually about 92:42). On basal third feebly but very broadly impressed from first interval to inner carinae. Apices broadly and conjointly rounded. Striae feebly impressed on sides and apical fourth, elsewhere not distinctly impressed; striae punctures deep, round and only occasionally on lateral intervals subquadrate. Intervals with the second and third slightly broader than sutural and with the others narrower; sutural, second, and third elytral intervals on basal third two and one-half times as broad as their respective punctures; surface of intervals occasionally smooth but generally with fine transverse wrinkles and with the punctures at base occasionally as coarse as coarse pronotal ones, though mostly about a fourth to a third as coarse as coarse pronotal ones and separated by two to five times their diameters. *Scutellum* subovate and surface with punctures which are finer and more sparsely separated than usual punctures of elytral intervals. *Prosternum* with the carinae present on basal three-fourths (not including process), straight, as wide apart as process at base, prominent on basal half and indistinct on apical fourth; sides of process strongly and broadly gibbous so that middle of process is concave; process as broad as in the great majority of the species and with the posterior margin feebly rounded, nearly truncate. *Metasternum* with the median longitudinal line attaining anterior fourth of disk, anteriorly fine but posteriorly, particularly on posterior third, broader and deeper. Disk only feebly convex on each side of median impression; surface of disk with the punctures usually round, about as coarse as coarsest of pronotum, and separated by less than twice their diameters; surface between punctures smooth, though at sides, particularly anteriorly, very densely set with punctures which are about a fifth again as coarse as usual ones and here also densely and finely eroded and with an occasional granule which is about half as broad as coarse mesal punctures. Abdominal sternites with the non-tomentose areas punctate as disk of metasternum except for basal three-fifths of basal segment which is slightly more coarsely and densely punctate. *Genitalia* of male as figured (text-figs. 347-352).

Female: Externally similar to male.

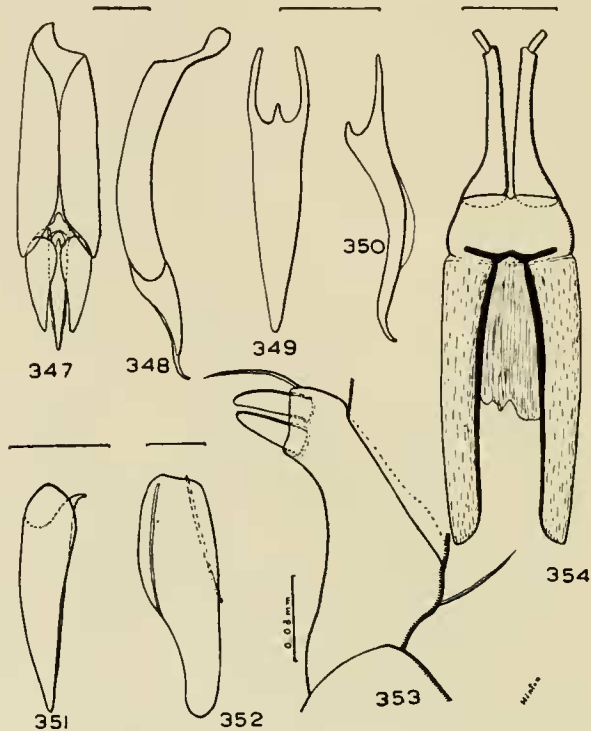
Type: In the British Museum (Nat. Hist.). MEXICO: Salazar (*Flohr*).

Specimens examined: MEXICO: 1, Salazar (*Höge*); 1, Las Vigas (*Flohr*); 4, Fedral District, La Venta, 1933 (*H. E. Hinton, R. L. Usinger*); and 160, Dist. de Temascaltepec, Temascaltepec to Las Cruces, alt. 5600-9000 ft., vi-vii. 1932-34 (1932, 1934, *H. E. Hinton*) (1933, *H. E. Hinton, R. L. Usinger*).

Variations: The punctuation of the various sclerites may be slightly finer or coarser than that of the specimen described above, the transverse impressions of the pronotum are often deeper and broader or shallower and narrower, and the median oval impression of the pronotal disk in exceptional cases is half as broad

and slightly longer than in the specimen described above. The transverse impression on basal third of elytra is occasionally absent. In a few specimens there is on the pronotal disk a narrow and very shallow impression extending from base to discal oval impression.

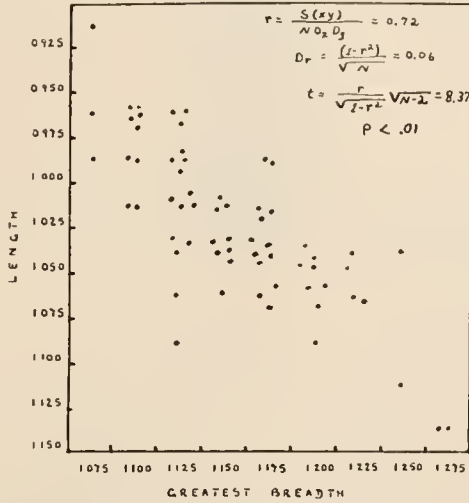
The following remarks apply to the District of Temascaltepec. *H. longula* occurred nowhere below 5600 ft. It was the only Elmids taken as high as 9000 ft. From my data it is not possible to determine at which altitude this species was most abundant. The majority of the specimens before me were taken at altitudes above 7000 ft. At this altitude most of the other Elmids began to fall off



TEXT-FIGS. 347-354.—*Heterelmis longula* Sharp. (347) Dorsal view of male genitalia. (348) Right lateral view of same. (349) Dorsal view of median lobe. (350) Right lateral view of median lobe. (351) Dorsal view of paramere. (352) Abdominal spicule of male. (353) First segment of front tarsus. (354) Female genitalia.

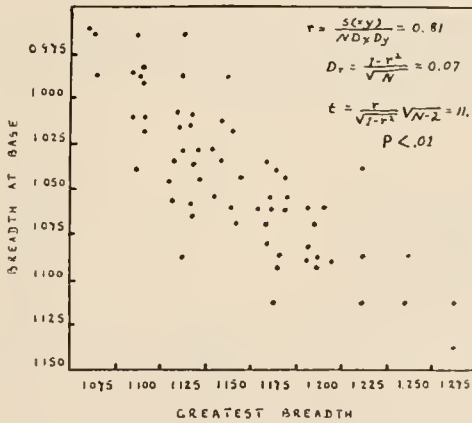
rapidly in numbers, so that even if the numbers of *longula* had remained constant at the different altitudes the method used for collecting would yield the greater number at the greater altitude. At 5600-7500 ft., for example, it was often not possible to examine more than 10 to 20 netfuls a day, so great were the numbers of Elmids in each netful, but at 8000 ft. more netfuls could be examined in the same time. The material was divided into two groups, 58 collected between 5600 and 7500 ft. and 66 collected between 7500 and 9000 ft. Owing to insufficient accurate altitude data the two groups are divided at the 7500-ft. level very inaccurately, and it is not unlikely that specimens placed in the first group in reality belong to the second and *vice versa*. However, this difficulty in separating the two samples at their adjacent levels does not materially affect what follows.

All specimens were measured for the length of the pronotum, breadth at base, breadth at broadest point (which is at about basal third), and breadth across apex. The results of a statistical study of these measurements are recorded in Table VIII. The chief interest of this table is that it shows that the individuals



355

TEXT-FIG. 355.—*Heterelmis longula* Sharp. Dot diagram of the correlation between the length of the prothorax and the breadth at broadest point. Measurements are given in mm.



356

TEXT-FIG. 356.—*Heterelmis longula* Sharp. Dot diagram of the correlation between the breadth at base of the prothorax and the breadth at broadest point. Measurements are given in mm.

living at altitudes of 5600–7500 ft. are on the whole larger than those living above 7500 ft. The differences between the means of the two samples may be regarded as significant for the four different measurements (Table IX). An increase in one of the prothoracic measurements indicates an increase in absolute size, for the length of the prothorax was found to be highly and positively correlated with the absolute length of the individual and the length of the prothorax highly and

positively correlated with its breadth. Using the formula $r = \frac{s(xy)}{NDxDy}$, where r is the coefficient of correlation, $S(xy)$ the sum of the products of x and y for each individual— x and y being the differences between the individual measures and their means, N is the number of individuals and Dx and Dy the standard deviation of the two series, $r = 0.720$ for length times breadth at broadest point (text-fig.

355). From the formula $Dr \frac{1-r^2}{\sqrt{N}}$ the standard deviation of the coefficient of

correlation is found to be 0.06. The formula $t = \frac{r}{\sqrt{1-r^2}} \sqrt{N-2}$ gives the

value of t as 8.37, and this value in Fisher's (1936) table VA shows that it is extremely improbable that the value for r should have arisen by random sampling from an uncorrelated population, the probability being very much less than 0.01. For breadth at broadest point times breadth at base (text-fig. 356) $r = 0.81 \pm 0.07$, $t = 11$ and $P < 0.01$.

TABLE VIII.

Sample.	Pronotum.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
A	Length	1.073	1.150	1.000	0.0342	0.00324	0.0043	58
B	"	1.035	1.150	0.925	0.0423	0.00368	0.0052	66
A	Broadest	1.198	1.325	1.075	0.0450	0.00426	0.0059	58
B	"	1.155	1.275	1.075	0.0478	0.00415	0.0059	66
A	Breadth at apex	0.784	0.850	0.725	0.0260	0.00246	0.0034	58
B	"	0.766	0.850	0.700	0.0282	0.00245	0.0035	66
A	" Base "	1.064	1.175	0.975	0.0396	0.00375	0.0052	58
B	"	1.054	1.150	0.975	0.0430	0.00372	0.0052	66

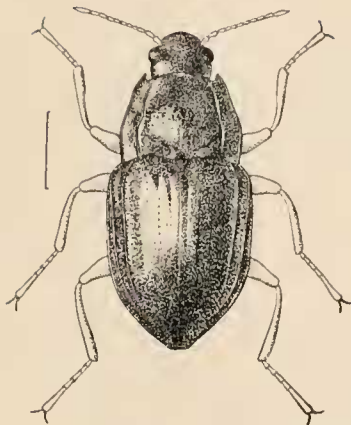
The altitude of sample A is 5600–7500 ft., while that of sample B is 7500–9000 ft. Measurements are given in mm. S.D. equals standard deviation, S.E.D equals standard error of the deviation, and S.E.M. equals standard error of the mean.

TABLE IX.

	Prothorax.	x.	P.
Length		5.43	$< 10^{-7}$
Breadth at broadest		4.82	$< 10^{-5}$
Breadth at apex		3.77	$= 10^{-4}$
Breadth at base		1.4	$= .16$

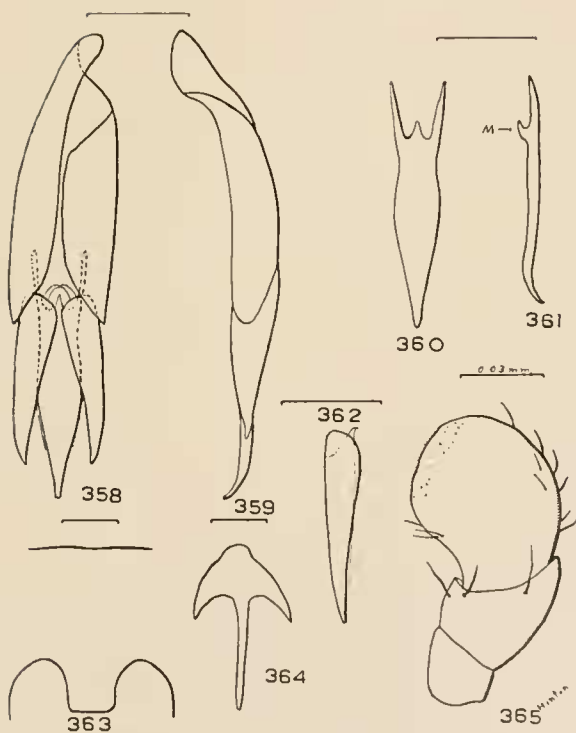
The significance of the difference between the means of the two samples of *longula* from different altitudes has been calculated from the formula $x = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$ where M is the mean and S.E.M. the standard error of the mean.

Comparative notes: This is the largest North American species of *Heterelmis*. It is close only to *H. obesa* from which it may be distinguished as follows: (1) the parameres of the male genitalia are broader in *longula*; and (2) the median lobe when seen from the side is broader and more sinuate, and the basal median projection is gradually sloping behind instead of strongly declivous as in *obesa* (cf. text-figs.). Nearly all individuals may be separated from *obesa* by their greater length, the pronotum nearly always being more than 0.925 mm. long. It has not been possible to separate very small females from large females of *obesa*.



357

TEXT-FIG. 357.—*Heterelmis obesa* Sharp.



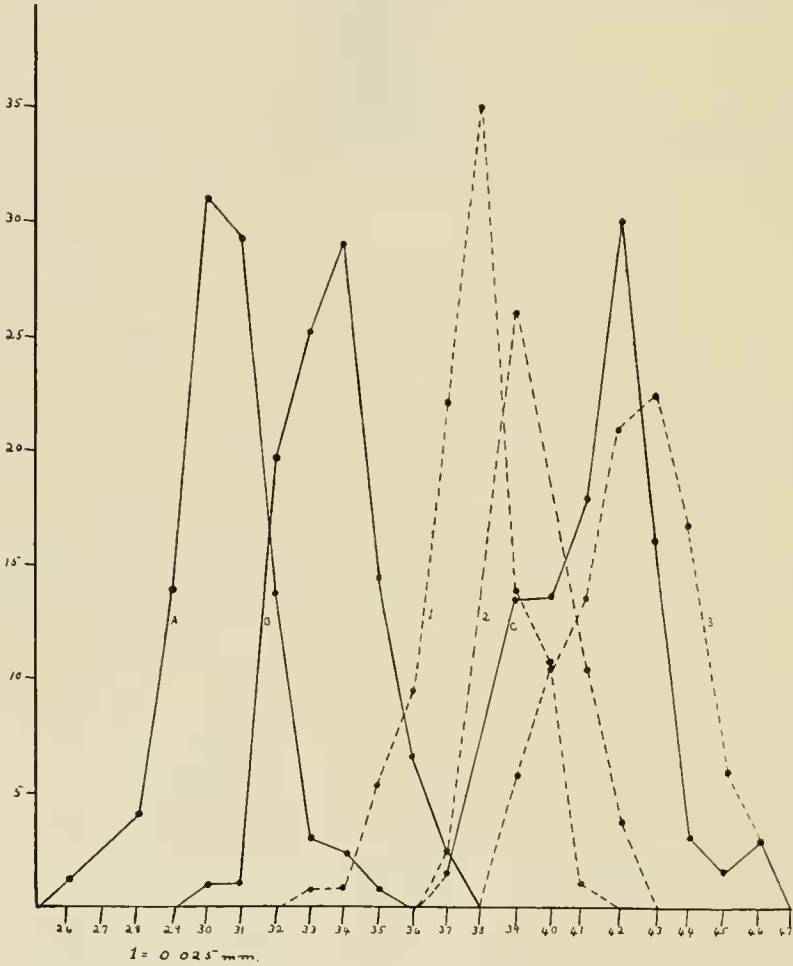
TEXT-FIGS. 358-365.—*Heterelmis obesa* Sharp. (358) Dorsal view of male genitalia. (359) Left lateral view of same. (360) Dorsal view of median lobe of male genitalia. (361) Right lateral view of median lobe. (362) Sublateral view of paramere. (363) Prosternum. (364) Sixth abdominal sternite of male. (365) Labial palp.

Heterelmis obesa Sharp.

(Text-figs. 357-365.)

1882. *Heterelmis obesus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 131, t. 4, f. 10.

Male : Length, 2.5 mm.-2.3 mm. ; breadth, 1.1 mm.-1.5 mm. Similar to *longula* except as follows : (1) length of prothorax nearly always less than 0.925



366

TEXT-FIG. 366.—Frequency polygons of prothoracic dimensions of *Heterelmis* adjusted to equal areas. Smooth line refers to length of prothorax, while broken line refers to its breadth at base. (A and 1) *H. obesa plana* Hinton ; (B and 2) *H. obesa* Sharp ; (C and 3) *H. longula* Sharp.

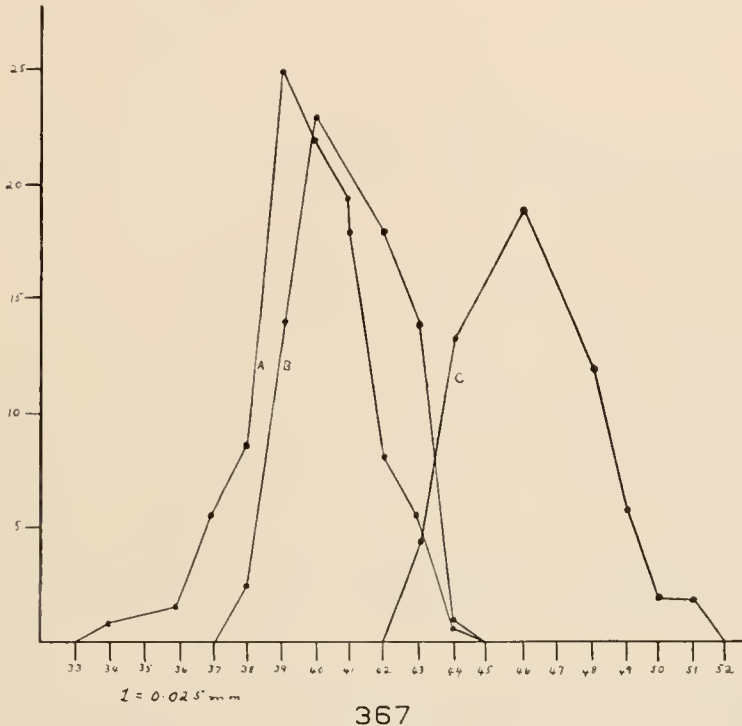
mm. ; (2) pronotum seldom with a median discal impression but in the rare specimen where this impression is well-developed it is never as deep as that of *longula*, though it is often proportionally as broad and long ; (3) elytra only rarely with a visible transverse impression on basal third ; (4) median lobe of male genitalia with the basal median projection, seen from the side, sharply

instead of gradually sloping behind; and (5) the parameres are narrower than those of *longula*.

Female: Externally similar to male.

Type: In the British Museum (Nat. Hist.). GUATEMALA: San Joaquin (G. C. Champion).

Specimens examined: 8, with same data as the type. 5003 from MEXICO as follows: 7, Altisco (F. D. Godman); District of Temascaltepec: 4708, Temascaltepec to Real de Arriba, alt. 5600-7500 ft., 5.vii.1932 (H. E. Hinton), 1933 (H. E. Hinton, R. L. Usinger), and 1934 (H. E. Hinton); 278, Rio Verde de la



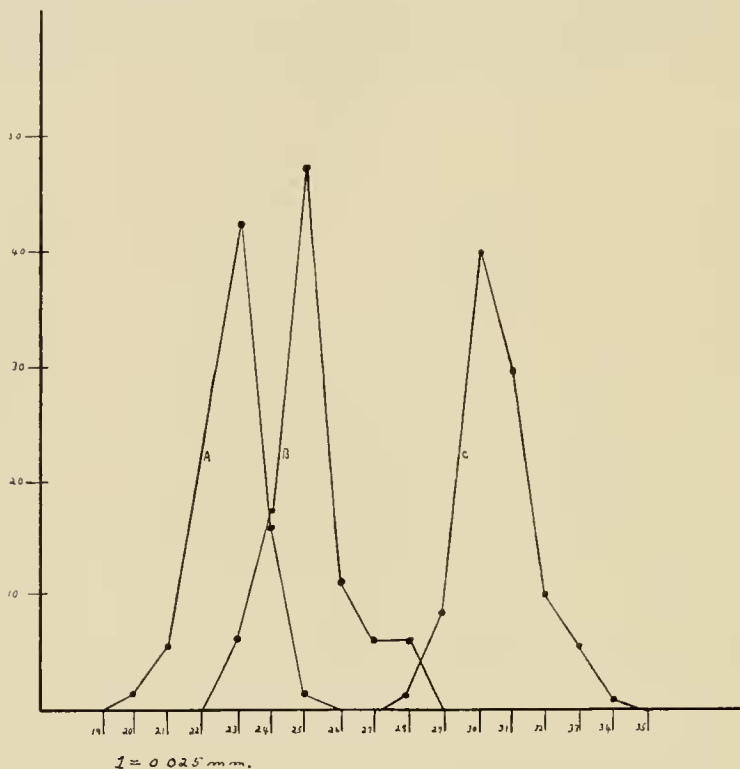
TEXT-FIG. 367.—Frequency polygons adjusted to equal areas of the breadth of the prothorax at broadest point. (A) *Heterelmis obesa plana* Hinton; (B) *H. obesa* Sharp; (C) *H. longula* Sharp.

Comunidad, alt. 8000 ft., 14.vi.1934 (H. E. Hinton); 1, Tejupilco, alt. 3500-4000 ft., vi-vii, 1932 (H. E. Hinton), 4, 1933 (H. E. Hinton, R. L. Usinger), and 1, 1934 (H. E. Hinton); 4, Estado de Morelos, Cuernavaca, alt. 4800 ft., vi.1934 (H. E. Hinton).

Variations: The punctuation of the various sclerites is similar to that of *longula*, and the variations in density are much the same. In a few specimens the transverse pronotal impression is barely noticeable, but in the great majority it is as well developed as that of *longula*.

A statistical study was made of the prothoracic measurements of two samples selected at random to find out if there was an increase of size with an increase in altitude. 45 specimens were taken from 5600-7500 ft. and 75 from 8000 ft., and the pronotum of all was measured for length, breadth at broadest point

(usually at about basal third), breadth across base, and breadth across apex. The results of this study are shown in Table X. Table XI shows that there are no significant differences between the means of the various prothoracic measurements, so that it appears that a difference in altitude of probably more than 500 ft. does not on the whole affect the absolute size of the individual.



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TEXT-FIG. 368.—Frequency polygons adjusted to equal areas of the breadth of the prothorax at apex. (A) *Heterelmis obesa plana* Hinton; (B) *H. obesa* Sharp; (C) *H. longula* Sharp.

TABLE X.

Numbers.	Pronotum.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.
75	Length	0.841	0.925	0.750	0.0345	0.00282	0.0040
45	"	0.826	0.875	0.775	0.0246	0.00260	0.0037
75	Broadest	1.024	1.100	0.950	0.0375	0.00315	0.0045
45	"	1.025	1.075	0.950	0.0340	0.00352	0.0050
75	Base	0.984	1.050	0.925	0.0305	0.00242	0.0035
45	"	0.990	1.050	0.925	0.0310	0.00328	0.0047
75	Apex	0.630	0.700	0.575	0.0335	0.00274	0.0033
45	"	0.625	0.675	0.575	0.0238	0.00251	0.0036

The sample, consisting of 75 specimens, was collected at 6000 ft., while the other was collected between 5600 and 7500 ft. Lengths are given in mm. S.D. equals standard deviation, S.E.D. equals standard error of the deviation, and S.E.M. equals standard error of the mean.

Comparative notes : Its small size usually enables it to be easily distinguished from *longula*, but, as may be seen from the frequency polygons (text-figs. 366-368), the various pronotal measurements occasionally overlap. When *obesa* is the same size as *longula*, the males can only be distinguished by an examination of the male genitalia and the females cannot, as far as I know, be separated.

TABLE XI.

Pronotum.	\bar{x} .	P.
Length	0.94	= .35
Breadth at broadest	0.06	= .95
Breadth at base	0.63	= .53
Breadth at apex	0.42	= .67

The difference between the means of the various pronotal measurements is significant in no case. Even where the difference is greatest, *i.e.* between the means for length, it is not twice the standard error of the mean.

Heterelmis obesa plana, subsp. n.

(Text-figs. 369, 370.)

Male : Length, 2.12 mm.-2.65 mm.; breadth, 1.00 mm.-1.25 mm. Similar to *obesa* except as follows : (1) there is no distinct transverse impression on the pronotum; (2) it is a slightly smaller species (Table XII); and (3) the pronotum is proportionally broader, the value for the mean of the length into that of the breadth at broadest point is 1.30, while the value for *obesa* is 1.24.

Female : Externally similar to male.

Type : ♂ in the British Museum (Nat. Hist.). MEXICO : Dist. de Temascaltepec, Tejupilco, alt. 3500-4000 ft., vii. 1934 (*H. E. Hinton*).

Paratypes : MEXICO : 7, with same data as type; 1178, Estado de Morelos, Cuernavaca, alt. 4800 ft., vi. 1934 (*H. E. Hinton*); 7, Sierra de Durango (*C. Schaufuss*); and 1, Cuantla (*Höge*).

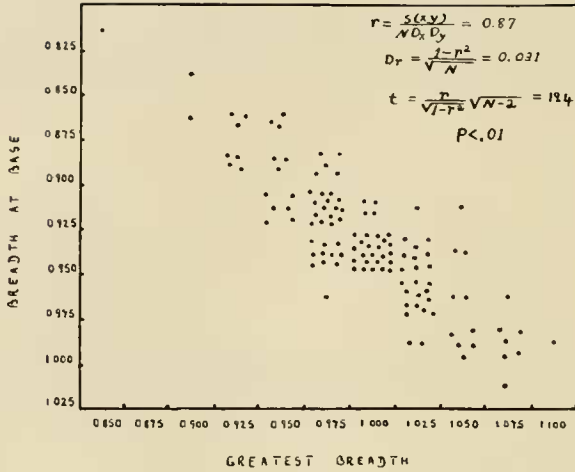
Variations : There is a little variation in the density of the punctures on various sclerites, but no other variations worthy of mention have been observed.

The coefficient of correlation, r , for length times breadth at broadest point is : $r = 0.79 \pm 0.034$, $t = 11.4$ and $P < 0.01$. For breadth at broadest point times breadth at base, $r = 0.87 \pm 0.03$, $t = 19.4$ and $P < 0.01$.

TABLE XII.

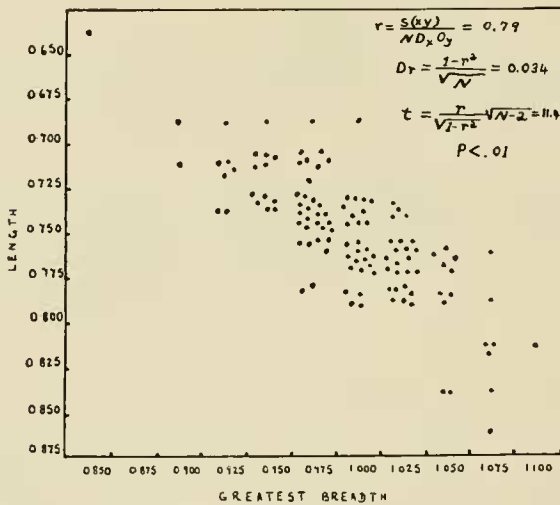
Pronotum.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
Length	0.763	0.875	0.650	0.0342	0.00250	0.00312	122
Broadest	0.094	1.100	0.850	0.0413	0.00265	0.00376	122
Base	0.944	1.025	0.825	0.0358	0.00220	0.00695	122
Apex	0.567	0.625	0.500	0.0222	0.00142	0.00376	122

Lengths given in mm. of various pronotal measurements of a sample selected at random of *H. obesa plana* from Cuernavaca. S.D. equals standard deviation, S.E.D. equals the standard error of the deviation, and S.E.M. equals the standard error of the mean.



369

TEXT-FIG. 369.—*Heterelmis obesa plana* Hinton. Dot diagram of the correlation between the breadth of the prothorax at base and the breadth at broadest point. Measurements are given in mm.



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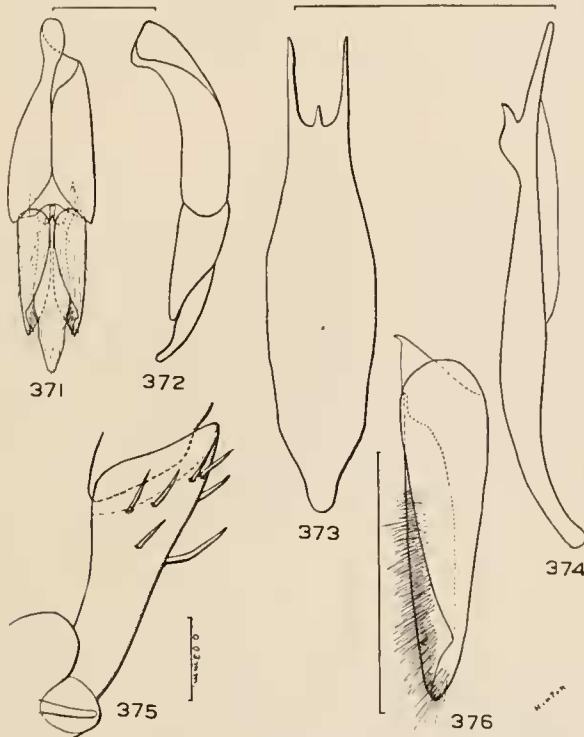
TEXT-FIG. 370.—*Heterelmis obesa plana* Hinton. Dot diagram of the correlation between the breadth of the prothorax at broadest point and its length. Measurements are given in mm.

***Heterelmis obscura* Sharp.**

(Text-figs. 371-376.)

1882. *Heterelmis obscurus* Sharp, *Biol. Centr.-Amer. Col.*, 1 (2) : 130.1888. *Heterelmis obscura* Grouvelle, *Ann. Soc. Ent. Fr.*, 8 (6) : 400, t. 7, f. 8.

Male: Length, 1.9 mm.-2.2 mm.; breadth, 0.9 mm.-1.1 mm. Similar to *H. obesa* except as follows: (1) the body is as a general rule proportionally more elongate, seldom as broad; (2) the impressions of the pronotum, particularly



TEXT-FIGS. 371-376.—*Heterelmis obscura* Sharp. (371) Dorsal view of male genitalia. (372) Left lateral view of same. (373) Dorsal view of median lobe. (374) Right lateral view of median lobe. (375) First segment of front tarsus. (376) Dorsal view of right paramere.

apical transverse impression, are deeper and more distinct, these impressions being similar to those of *longula* but the median discal impression is as a rule not so well developed; (3) the ventral apex of the basal segment of all tarsi is as figured (text-fig. 375), *i.e.* without two stout spines as in *obesa* and other members of the *longula* group; and (4) the parameres of the male genitalia (text-figs. 371-374, 376) have a conspicuous fringe of fine, long hairs on the inner apical half.

Female: Externally similar to male.

Type: In the British Museum (Nat. Hist.). GUATEMALA: San Joaquin (*G. C. Champion*).

Specimens examined: 34, with same data as type; and 3, GUATEMALA: Guatemala City (*G. C. Champion*). TEXAS: 1, Ft. Sam Houston. COSTA RICA:

1, San Jose, alt. 1000-1200 m., 18.v.1931 (*F. Nevermann*); and 1, Coronado, alt. 1400-1500 m. 1607 from MEXICO as follows: 249, Estado de Morelos, Cuernavaca, alt. 4800 ft., vi.1934 (*H. E. Hinton*); Dist. de Temascaltepec: 21, Tejupilco, alt. 3500-4000 ft., vi-1933 (*H. E. Hinton, R. L. Usinger*); 13, as preceding but in vii.1934 (*H. E. Hinton*); 1324, from Temascaltepec to Rio Verde de la Comunidad, alt. 5600-8000 ft., v-vii (1932, 1934, *H. E. Hinton*) and 1933 (*H. E. Hinton, R. L. Usinger*).

Other locality records: Grouvelle (1888, *loc. cit.*) has recorded this species from Theresopolis, Brazil, but since he did not compare the male genitalia of his specimens with those of typical *obscura* from Central America, his locality record cannot be considered as proof that this species occurs in southern Brazil.

Variations: As usual, the punctures on the different sclerites vary slightly in density, and, apart from size, no other variations worthy of mention have been observed.

TABLE XIII.

Numbers.	Pronotum.	Mean.	Max.	Min.	S.D.	S.E.D.	S.E.M.
28	Length	0.682	0.725	0.625	0.0256	0.00349	0.00495
38	"	0.662	0.725	0.600	0.0290	0.00334	0.00477
73	"	0.650	0.700	0.600	0.0242	0.00202	0.00280
14	"	0.648	0.700	0.600	0.0340	0.0057	0.00835
28	Broadest	0.826	0.900	0.750	0.0325	0.00432	0.00627
38	"	0.802	0.850	0.750	0.0265	0.0034	0.00435
73	"	0.795	0.875	0.725	0.0339	0.00282	0.0040
14	"	0.788	0.825	0.750	0.0257	0.00485	0.00705
28	Base	0.784	0.850	0.725	0.0375	0.00419	0.00593
38	"	0.770	0.850	0.725	0.0265	0.0035	0.00437
73	"	0.754	0.825	0.700	0.0312	0.0026	0.00368
14	"	0.750	0.775	0.700	0.0218	0.00413	0.00607
28	Apex	0.541	0.575	0.475	0.0255	0.00348	0.00495
38	"	0.534	0.575	0.500	0.0229	0.00375	0.00377
73	"	0.528	0.575	0.475	0.0210	0.00175	0.00248
14	"	0.525	0.575	0.500	0.0183	0.00345	0.00507

The sample of 28 specimens is from Rio Verde de la Comunidad, alt. 8000 ft.; that of 38 is from Temascaltepec to Real de Arriba, alt. 5600-7500 ft.; that of 73 is from Cuernavaca, alt. 4800 ft.; and that of 14 is from Tejupilco, alt. 3500-4000 ft. The measurements are given in mm. S.D. equals the standard deviation, S.E.D. equals the standard error of the deviation, and S.E.M. equals the standard error of the mean.

A statistical study was made of the length of the pronotum and the breadth at three different points. The samples were selected at random and each of the four samples is from a different altitude. The results of this study are recorded in Table XIII, and the significance of the difference of the means for all possible pairs of altitude samples is given in Table XIV. A comparison of the sample (73) collected at Cuernavaca (4800 ft.) with (14) that collected at Tejupilco (3,500-4000 ft.) shows that for each pronotal measurement the mean value is slightly greater for the former, but in no case is the difference significant. The minimum difference in the altitude between these two samples is 800 ft. This fact justifies the conclusion that in latitude 19° N. a difference in altitude of more than 800 ft. is probably necessary before any significant difference in size can be detected.

TABLE XIV.

Sample.	Length of pronotum.		Broadest point.		Breadth at base.		Apex.	
	x	P	x	P	x	P	x	P
28 } 73 }	5.4	< 10 ⁻⁷	4.1	< 10 ⁻⁴	4.38	= 10 ⁻⁵	2.29	> .03
38 } 28 }	3.01	< .01	2.84	< .01	1.84	< .07	1.11	.27
38 } 73 }	1.77	— .07	1.26	= .21	2.98	< .01	1.29	— .20
28 } 14 }	3.49	< 10 ⁻³	4.04	< 10 ⁻¹	4.00	— 10 ⁻⁴	2.26	= .03
38 } 14 }	1.35	— .18	1.81	— .07	2.72	< .01	1.45	— .15
73 } 14 }	0.35	— .72	0.94	— .35	0.48	= .63	0.60	— .55

The altitudes of the four samples are given in Table XIII. The significance of the difference between the means of the samples was calculated from the formula $x = \frac{M_1 - M_2}{\sqrt{(S.E.M._1)^2 + (S.E.M._2)^2}}$ where M is the mean and S.E.M. the standard error of the mean. The probabilities, P , for the various values of x were found in Fisher's (1936) table of x .

Comparative notes: No difficulty is met with in distinguishing *H. obscura* from the species belonging to the *H. longula* group, all of which have the first segment of the tarsi modified. In size and general appearance *obscura* only approaches—of those species I have already dealt with—*obesa*, and apart from the differences mentioned above, the pronotal measurements of these two but rarely overlap; and in practice it has been possible to separate them on size with great ease, only about 1 in 200, being mistaken.

Heterelmis acicula, sp. n.

(Text-figs. 377–381.)

Male: Length, 1.9 mm.–2.2 mm.; breadth, 1.0 mm.–1.1 mm. Similar to male of *obscura* except as regards the structure of the male genitalia (*cf.* text-figs.) which differ as follows: (1) the parameres are more slender and the apical fringe of hairs is sparser; (2) the median lobe is narrower (0.0170 mm. broad) opposite apices of parameres, whereas the median lobe of *obscura* at the same point is 0.050 mm. broad; and (3) the basal median projection of the median lobe is, when seen from the side, rounded instead of pointed at the end, and immediately behind is strongly instead of feebly sinuate.

Female: Unrecognized. There are probably a number of females before me, but if so, I cannot distinguish them from the females of *obscura*. This means that wherever *obscura* and *acicula* are found together, *e.g.* in Tejupilco, female specimens cannot be assigned to their respective species.

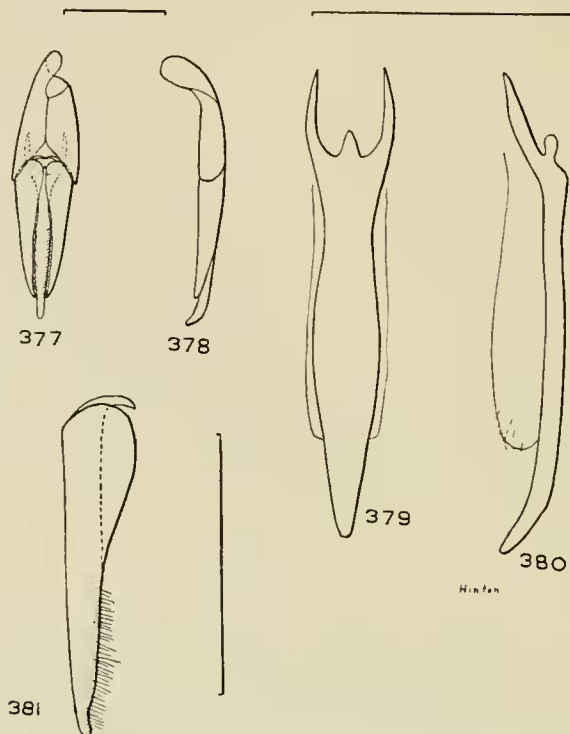
Type: ♂ in the British Museum (Nat. Hist.). MEXICO: Dist. de Temascaltepec, Tejupilco, alt. 3500–4000 ft., vii. 1934 (*H. E. Hinton*).

Paratypes: 15, with data as above; and 16, collected in the same locality in vi. 1933 (*H. E. Hinton, R. L. Usinger*).

Variations: No variations worthy of mention have been observed.

Comparative notes: 19 male specimens were used in a statistical study to determine the means of four pronotal measurements and the significance of the

differences between these means and those of 14 male specimens of *H. obscura* also collected in Tejupilco. From the results given in Table XV it is obvious that *acicula* is a smaller species. In Table XVI the probabilities of the two species being homogeneous for size are given. When *acicula* occurs at the same altitude and latitude as *obscura* it is a smaller species. It is important to remember that these size differences between the two species only apply in the same altitudes and latitudes, e.g. if the great difference in the size of *obscura* taken above 7000 ft. and below 4000 ft. is considered, it can be reasonably inferred that at lower altitudes than Tejupilco we will get populations equal in size to those of *acicula* at Tejupilco.



TEXT-FIGS. 377-381.—*Heterelmis acicula* Hinton. (377) Dorsal view of male genitalia. (378) Left lateral view of same. (379) Dorsal view of median lobe of male genitalia. (380) Left lateral view of same. (381) Dorsal view of left paramere.

LARVAE.

The larvae have not been associated with *Heterelmis* by rearing but by constantly finding them associated with the adults over a number of years and in many localities in Mexico, Peru, Bolivia, Brazil, French Guiana, and Trinidad (B.W.I.). A distributional map of the larvae here considered to belong to *Heterelmis* will fit only that of the adults of *Heterelmis*.

Generic Characters of Larvae of Heterelmis.

Body subparallel and cylindrical to subtriangular in cross section; dorsal surface (except for ninth abdominal tergite which has median longitudinal ridge)

evenly convex and with parallel, feebly oblique rows of closely placed and large tubercles each of which bears a large, stout spine. *Head* when seen from above exposed and not concealed by the pronotum; anterior margin on each side between base of antenna and clypeus with a large and acute tooth. Clypeus with the fronto-clypeal suture well developed. With one ocellus on each side. Antenna (Text-fig. 388) 3-segmented and feebly retractile. Mandibles of both sides similar and with three obtuse, apical teeth; prostheca long, slender, and densely spinose. Maxilla (text-fig. 386) with the palp 4-segmented and the stipes showing no differentiation into a palpifer; galea and lacinia separate and apex

TABLE XV.

Species.	Pronotum.	Mean.	Max	Min.	S.D.	S.E.D.	S.E.M.	Numbers.
<i>obscura</i>	Length	0.648	0.700	0.600	0.0340	0.0057	0.00835	14
<i>acicula</i>	"	0.616	0.650	0.600	0.0151	0.00245	0.00300	10
<i>obscura</i>	Broadest	0.788	0.825	0.750	0.0257	0.0048	0.00705	14
<i>acicula</i>	"	0.705	0.800	0.725	0.0191	0.0031	0.00452	10
<i>obscura</i>	Base	0.750	0.775	0.700	0.0218	0.0041	0.00607	14
<i>acicula</i>	"	0.727	0.750	0.700	0.0165	0.0026	0.00388	10
<i>obscura</i>	Apex	0.525	0.575	0.500	0.0183	0.0034	0.00507	14
<i>acicula</i>	"	0.491	0.525	0.475	0.0160	0.0027	0.00307	10

Measurements are given in mm. S.D. equals standard deviation, S.E.D. equals standard error of the deviation, and S.E.M. equals standard error of the mean. Both samples are from Tejuipilco, alt. 3500-4000 ft.

TABLE XVI.

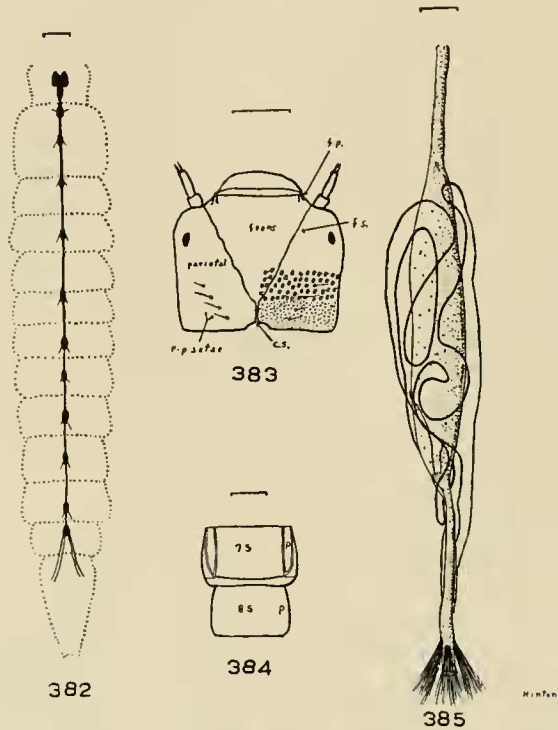
Pronotum.	x.	P.
Length	3.51	< 10 ⁻³
Breadth at broadest	2.58	= .01
Breadth at base	3.09	= 10 ⁻³
Breadth at apex	4.40	< 10 ⁻⁶

The significance of the difference of the means of four pronotal measurements of *obscura* compared with *acicula* was calculated from the formula $x = \frac{M_1 - M_2}{\sqrt{(S.E.M_1)^2 + (S.E.M_2)^2}}$ where M is the mean and S.E.M. the standard error of the mean. The probabilities for various values of x were found in Fisher's (1936) table of x. The samples of both species are from Tejuipilco.

of each densely spinose. Labium with the postmentum undivided; labial palp (text-fig. 387) 2-segmented and prementum without a distinct palpiger. Gula well developed. Prothoracic pleura (text-fig. 391) divided into two parts and anterior part meeting on middle line of body so that the sternum is here completely suppressed. Meso- and metapleura divided into three parts on each side (text-fig. 391). Abdominal segments one to seven with the pleura bounded by tergo- and sterno-pleural sutures which in seventh segment (text-fig. 384) converge and meet near posterior margin; segment 8 forming a complete sclerotized ring; apex of ninth very feebly and broadly, arcuately emarginate. Operculum (text-fig. 401) with two strongly sclerotized claws (text-fig. 398) attached to its dorsal membrane. Spiracles present on mesothorax and first eight abdominal segments and opening at apices of small tubercles; tracheae without air sacs; with three tufts of anal, retractile, tracheal gills. *Alimentary canal* (text-fig. 385)

with an oesophageal sclerite on the dorsal posterior margin of the oesophagus. Hind gut with six Malpighian tubules which end freely near the rectum. *Central nervous system* (text-figs. 382) with three thoracic and eight abdominal discrete ganglia.

The larvae of this genus have a very characteristic appearance due to the slightly oblique and parallel rows of close and large tubercles. Each tubercle bears a spine so that the larvae appear to have a series of sharply carinate ridges when viewed dorsally. The division of the meso- and metapleura into three parts on each side will distinguish the genus from all genera except *Phanocerooides* Hinton,



TEXT-FIGS. 382-385.—Larva of *Heterelmis longula* Sharp. (382) Central nervous system. (383) Dorsal view of head. (384) Ventral view of seventh abdominal segment to show sclerotization. (385) Alimentary canal.

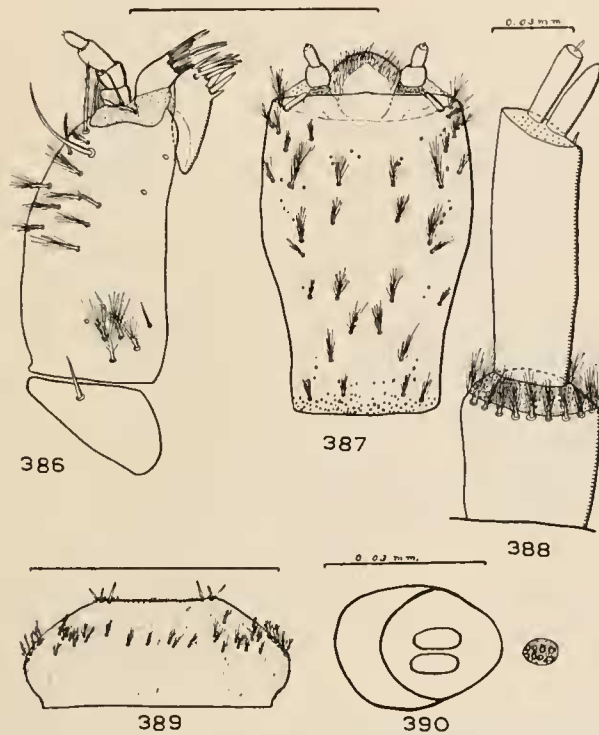
and from this it may be distinguished as follows: (1) its cylindrical instead of flattened and onisciform body; (2) the prothoracic pleura are divided into anterior and posterior parts, whereas in *Phanocerooides* they are undivided; and (3) by the eighth abdominal segment which here forms a complete sclerotized ring, whereas in *Phanocerooides* it has the pleura bounded by tergo- and sterno-pleural sutures.

Description of Mature Larva of Heterelmis longula Sharp.

(Text-figs. 382-401.)

Length, 7.6 mm.; breadth, at broadest point which is near apex of abdomen 1.0 mm. *Head* with the frontal sutures complete (text-fig. 383); coronal

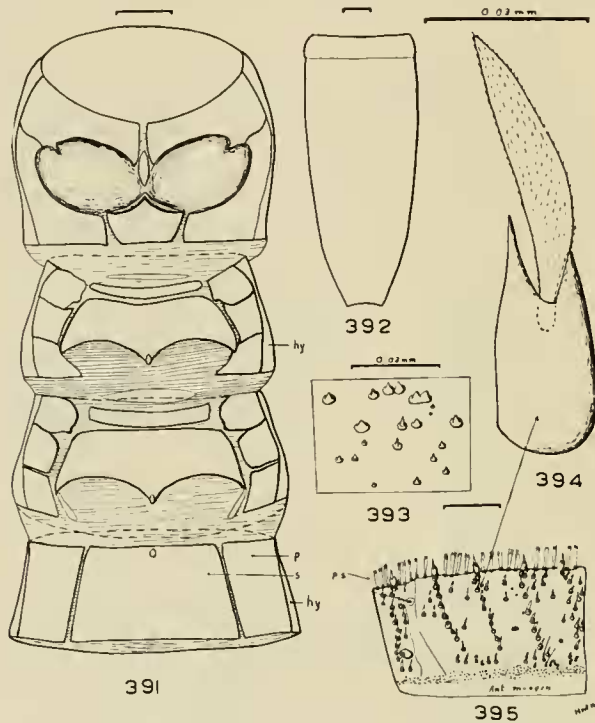
suture short (text-fig. 383); head without other sutures. Parietals finely tuberculate on a basal belt which is as long as coronal suture; elsewhere for the most part tuberculate as figured (tuberculate area of drawing) (text-fig. 383) and with a number of fine setae; four post-parietal setae (text-fig. 383) placed in an oblique row. Frons with a tooth-like process on each side and with the surface tuberculate as the parietals. Clypeus about as broad as base of labrum but only about a third as long. Labrum as figured (text-fig. 389). Ocellus on each side composed of a single large pigmented area and hence not distinctly faceted.



TEXT-FIGS. 386-390.—Larva of *Heterelmis longula* Sharp. (386) Ventral view of right maxilla. (387) Ventral view of labium. Setae of prementum are only placed to give general appearance of this region. (388) Dorsal view of left antenna. (389) Dorsal view of labrum. (390) Mesothoracic spiracle.

Antenna with the setae as figured (text-fig. 388). Mandibles of both sides similar; one-fourth longer than broad at broadest point which is at base; and with a seta-like prostheca which is about two-thirds as long as mandible and is itself densely and very finely setose. Maxilla and labium with the setae as figured (text-figs. 386, 387). Pronotum at broadest point, which is near base, slightly broader than long (0.925 mm. : 0.850 mm.); anterior margin broadly and feebly arcuate, apical angles obliterated, sides feebly arcuate, basal angles inconspicuous and broadly rounded, and base feebly arcuate for its entire breadth; surface very evenly convex; surface anteriorly with round to oval setose tubercles which are about 0.025 mm. broad and are separated by less than to twice their diameters; on posterior three-fifths of pronotum most of these tubercles are arranged in five

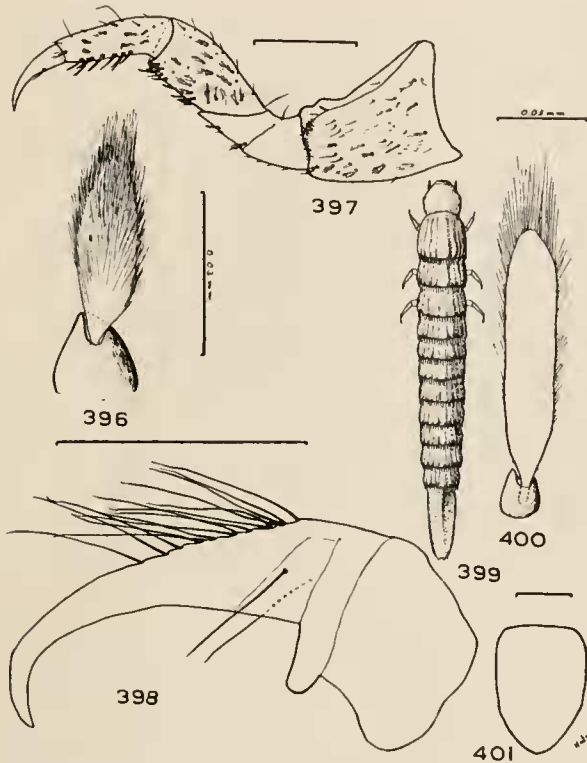
rows on each side which are feebly oblique towards sides and become increasingly well defined posteriorly; posteriorly the tuberculation of this tergite resembles that of the fifth abdominal segment (*vide* text-fig. 395); anteriorly this segment has a row of flat setae which is similar to posterior row and both of these rows are similar to posterior row of fifth tergite (text-fig. 395). Tergites of mesothorax, metathorax, and first eight abdominal segments with the ratio of breadth to length as follows: 0.950 mm. : 0.450 mm.; 0.975 mm. : 0.450 mm.; 1.00 mm. : 0.400 mm.; 1.00 mm. : 0.400 mm.; 0.975 mm. : 0.450 mm.; 0.925 mm. : 0.425



TEXT-FIGS. 391-395.—Larva of *Heterelmis longula* Sharp. (391) Ventral view of thorax and first abdominal segment to show sclerotization. (392) Dorsal view of ninth abdominal segment. (393) Section to show tuberculation near anterior margin of fifth abdominal tergite. (394) One of the tubercles forming the rows on fifth abdominal tergite. (395) A section of fifth abdominal tergite to show various types of tubercles.

mm.; 0.850 mm. : 0.425 mm.; 0.800 mm. : 0.450 mm.; 0.700 mm. : 0.425 mm. 0.625 mm. : 0.375 mm.; all of these tergites are alike in having the anterior and posterior margins nearly truncate, the sides feebly arcuate, the apical and basal angles broadly rounded, the surface evenly convex, and the tubercles and setae as shown in text-fig. 395. Ninth abdominal tergite with the outline as shown in text-fig. 392; with a median ridge extending from base to apex and on this ridge are two nearly contiguous rows of tubercles, the rows diverging slightly basally; on each side with an extreme dorso-lateral row of setose tubercles extending from base to apex, and also on each side with a ventro-lateral row of similar tubercles; areas between these rows of tubercles have themselves somewhat similar rows of tubercles which are separated by less than to twice their diameters; apical

margin with a conspicuous fringe of posteriorly directed setae which are about 0.03 mm. long. *Ventral surface* with the setose tubercles about two-thirds as coarse as those of tergites and usually separated by one to three times their diameters—two common types are figured from the fifth abdominal sternite (text-figs. 396 and 400), and there are setae showing every intergradation between them. Operculum with the shape as figured (text-fig. 401) and the claws as figured (text-fig. 398). *Legs* all somewhat similar to front leg (text-fig. 397).



TEXT-FIGS. 396-401.—Larva of *Heterelmis longula* Sharp. (396) One of the types of seta found on the fifth abdominal sternite. (397) Inner face of right front leg. (398) Dorsal face of right opercular claw. (399) Mature larva to show general appearance. (400) One of the types of seta found on the fifth abdominal sternite. (401) Operculum.

Specimens examined: 4, MEXICO: Dist. de Temascaltepec, Las Cruces, alt. 9000 ft., vi. 1934 (*H. E. Hinton*).

In addition there are 119 larvae collected in the same district from Tejuvilco alt. 3500 ft., to Rio Verde, alt. 8000 ft.; and 31, MEXICO: Estado de Morelos, Cuernavaca, alt. 4800 ft., vi. 1934 (*H. E. Hinton*).

From the distributional data available it is evident that there are at least two species and one variety before me (*longula*, *obesa*, and *obesa plana*) and possibly two other species (*obscura* and *acicula*). The larvae of *longula* were determined as such by the altitude data, this being the only species which occurs in the Dist. de Temascaltepec as high as 9000 ft. What is apparently the last stage larva of

this species may be distinguished from the last stage larva taken at Cuernavaca (where *longula* does not occur) as follows:

- i. Abdominal tergites of last stage larva without tubercles or only with an occasional smaller tubercle between first and third rows of tubercles
H. obesa, *H. obesa plana*, and *H. obscura*.
- Abdominal tergites of last instar larva with numerous large tubercles between the first and third rows of tubercles (text-fig. 395) *H. longula*.

Larvae representing probably three earlier instars are before me. These are all alike and similar to the mature larva except in the case of *longula* where the mature larva has numerous tubercles between first and third rows of tubercles of abdominal terga.

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